Chapter Eight: Contents

(Output Visualizer – 04 March 2002 – LA-UR-00-1725 – TRANSIMS 3.0)

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1. INTRODUCTION

1.1 Overview

The TRANSIMS Output Visualizer module enables users to display various input and output data sets; it also provides tools to facilitate the analysis of these data sets. Among the data types the Output Visualizer displays/analyzes are the following:

- Plans—single aggregated or filtered overlaid on a given network.
- Vehicles—can be colored by velocity, type, etc., and animated on a given network.
- Signals—traffic controls are drawn and animated on a given network.
- Summary data – velocity and density data are drawn and animated on a given network.
- Intersection queues—queues are drawn and colored by the vehicles in a given queue.
- Variable size box data—any user-selectable data value can be drawn on any link of any size on a given network; this makes it possible to display data of vastly different types (from emissions levels to plans).
- Polygonal Region data – any user-selectable data value can be drawn on any region defined by a set of vertices; this makes it possible to display data aggregated into regional areas.

1.2 Requirements

The Output Visualizer currently runs under Sun Solaris and Linux operating systems. Hardware requirements include only a three-dimensional capable graphics board, such as a Creator3D or better for Sun workstations, or an OpenGL-compatible graphics board for systems running Linux.

OpenGL-compatible graphics boards for Intel/Linux systems add very little to the cost of machines; in fact, most laptops will run the Output Visualizer without the addition of a graphics-board upgrade. A three-button mouse is also required for Sun Solaris systems. A three-button mouse is preferred for Linux systems, although a two-button mouse may be configured to emulate a three-button mouse. Software requirements include the following:

- OpenGL or Mesa3D-graphics library
- GLUT, a multi-platform windowing system library

2. USING THE OUTPUT VISUALIZER

2.1 Graphical User Interface

The Output Visualizer's graphical user interface enables users to manipulate three-dimensional objects. As shown in Fig. 1 , the toolbar within the interface consists of buttons and sliders designed to achieve this purpose.

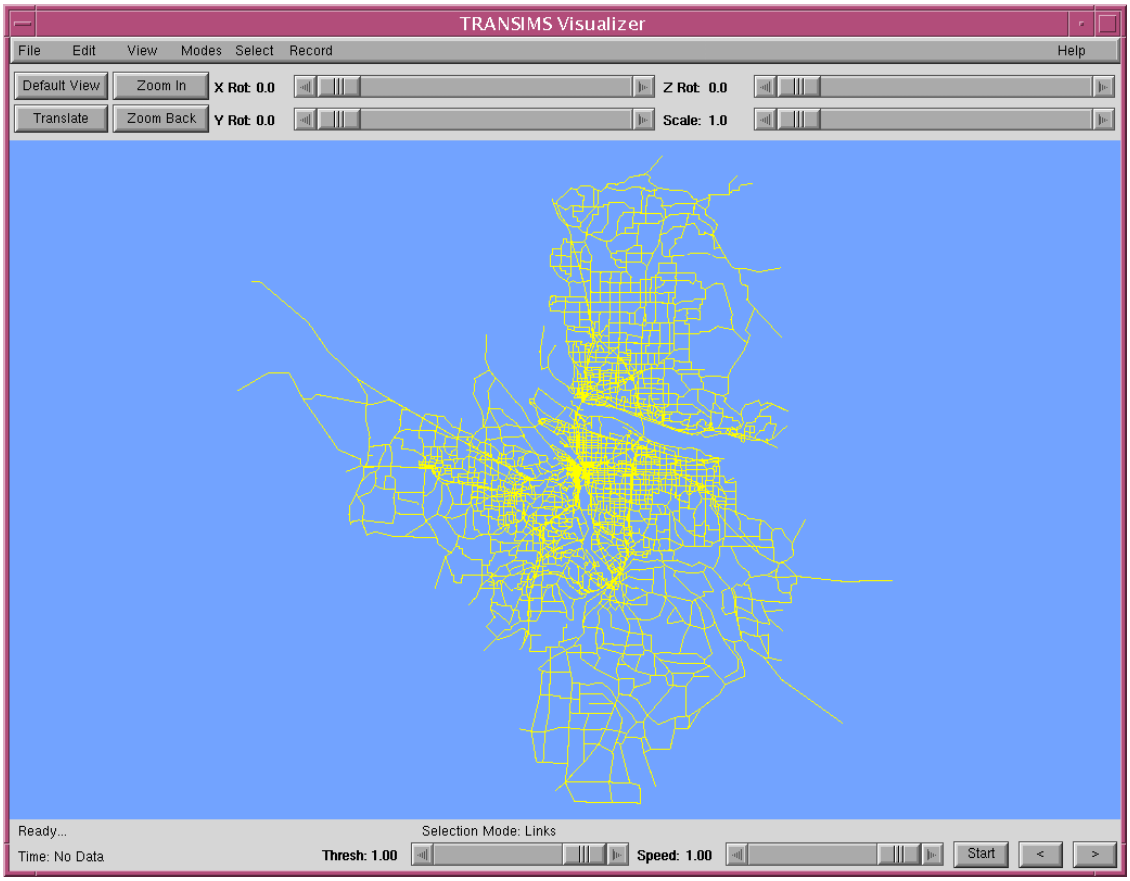

Fig. 1. This figure shows the Output Visualizer graphical user interface.

The sliders rotate the object about any axis and can also be used to scale the object about the current center of the display. Table 1 describes the buttons.

Table 1. Output Visualizer buttons.

Button	Description
Default View	Resets the viewing transformations to their default values.
Translate	Enables users to drag objects to a new location by • clicking on the button, • clicking on any point in the viewing area, • dragging it to another point, and • releasing the left-mouse button.
Zoom In	Enables users to magnify the display of a selected area by • clicking on the button, then • using the left-mouse button to click and drag on the display area, thus provide more detail
Zoom Back	Resets the viewing transformations to those that existed before the last zoom-in command. A stack of 50 zooms is implemented in the Output Visualizer.

Just below the viewing window is the status line, which shows whether the display is animating or ready for commands. It also displays warnings and error messages.

To the right of the status line is the selection status line, which displays the current selection mode and the data retrieved from selections. The bottom edge of the display is used to display the current timestep and variable being displayed, as well as certain mode indicators.

Just to the right is the Thresh slider, which controls the transparency of vehicles or the cycling of colormaps, depending on what type of data are being viewed (vehicles or box data, respectively).

The Animation-speed slider is to the right and defaults to the fastest animation speed of 1.0. The start button resets the currently shown timestep to the first available timestep in the currently loaded data. The “>” and the “<” buttons increase and decrease the currently displayed timestep.

The Output Visualizer’s user interface has seven pull-down menus. These menus are described in Table 2.

Table 2. Output Visualizer pull-down menus.

Menu	Description
File	Opens and closes data files, saves the viewing area to a file, saves and reads configuration files, and processes batch command files.
Edit	Finds objects, allows labeling, and changes the background color.
View	Enables users to select what type of data to view, as well as the data’s display style.
Modes	Selects various viewing modes, such as whether to use the lighting model, overlay mode, two- or three-dimensional network, etc.

Menu	Description
Select	Enables users to change what types of objects are searched for when the middle mouse button is clicked in the viewing area.
Record	Allows for the automated saving of images in a user-selected sequence of transformations and time-series displays in standard video sizes.
Help	Allows the user to access the help facility.

Note: Initially, the Output Visualizer displays the network described in the configuration file.

2.2 Menu Functionality

2.2.1 File Menu

The File menu provides options (Table 3) for opening and closing data files, saving the current viewing area as a Sun Raster image file, saving the current display into a user-selectable size portable pixmap file, and exiting the Output Visualizer.

Table 3. File menu functionality.

Menu Option	Description
Open Indexed Vehicles	Reads in and displays vehicle snapshot data from an indexed binary file that summarizes vehicle locations, types, velocities, etc. Refer to the File Formats section for additional information on the indexed binary-vehicle snapshot file format. Files in this format are produced with the *indexvehtobin* utility. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed. The amount of data kept in memory can be adjusted when the Edit→Vehicle Memory Usage menu option has been selected.
Open Intersection Queues	Reads in and displays intersection queue data. The intersection queue file is created by the output system. Refer to the File Formats section for additional information on the intersection queue file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed. The intersection queues will be displayed and synchronized with the vehicle snapshot file if one is currently loaded. Text output of intersection queues can be obtained by clicking the middle mouse button on an intersection when the Select→Intersection Queues menu option has been selected.

Menu Option	Description
Open Link Data	Reads in and displays link data. The link evolution data file is not created by the output system. Refer to the File Formats section for additional information on the link evolution data file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Open Link Space Summary Data	Reads in and displays link space summary data. The link space summary data file is created by the output system. Refer to the File Formats section for additional information on the link space summary data file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Open Network Features	Reads in and displays the network feature data. The network feature data file is not created by the output system. Refer to the File Formats section for additional information on the network feature evolution data file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Open Point Data	Reads in and displays point data. The point data file is not created by the output system. Refer to the File Formats section for additional information on the point evolution data file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Open Polygonal Region Data	Reads in and displays polygonal region data. The polygonal region data file is not created by the output system. Refer to the File Formats section for additional information on the polygonal region data file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Open Traffic Controls	Reads in and displays traffic control data. The traffic control file is created by the output system. Refer to the File Formats section for additional information on the traffic control file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.

Menu Option	Description
Open Underlay File	Opens a text-based data file that describes polygons to draw in the display area. The polygons are not timestep dependent, they are drawn on the display the same way in every timestep and even when no data is loaded into the Output Visualizer. This file format allows for the addition of features such as adding buildings and/or rivers to the display. Refer to the File Formats section for additional information on the underlay file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Open Variable Size Box Data	Opens a text-based, variable size box data file. This option is used for emissions, summary data, and any type of data that are displayable on links. The File Selector dialog box (Fig. 2) is displayed, which enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Close Indexed Vehicles	Deallocates memory used for the current indexed vehicle snapshot data; the data will no longer be accessible. This menu option should be selected before reading in a new indexed vehicle snapshot file or in recovering memory for use in displaying another data type.
Close Intersection Queues	Deallocates memory used for the current intersection queue evolution data; the data will no longer be accessible. This menu option should be selected before reading in a new intersection queue file or in recovering memory for use in displaying another type of data.
Close Link Data	Deallocates memory used for the current link evolution data; the data will no longer be accessible. This menu option should be selected before reading in a new link evolution data file or in recovering memory for use in displaying another type of data.
Close Link Space Summary Data	Deallocates memory used for the current link space summary data; the data will no longer be accessible. This menu option should be selected before reading in a new link space summary data file or in recovering memory for use in displaying another type of data.
Close Network Features	Deallocates memory used for the current network features data; the data will no longer be accessible. This menu option should be selected before reading in a new network features evolution file or in recovering memory for use in displaying another type of data.
Close Point Data	Deallocates memory used for the current point data; the data will no longer be accessible. This menu option should be selected before reading in a new point data file or in recovering memory for use in displaying.

Menu Option	Description
Close Polygonal Region Data	Deallocates memory used for the current polygonal region data; the data will no longer be accessible. This menu option should be selected before reading in a new polygonal region data file or in recovering memory for use in displaying.
Close Traffic Signals	Deallocates memory used for the current traffic signal snapshot data; the data will no longer be accessible. This menu option should be selected before reading in a new traffic signal snapshot file or in recovering recover memory for use in displaying another type of data.
Close Underlay File	Deallocates memory used for the current underlay file; the data will no longer be accessible. This menu option should be selected before reading in a new underlay file or in recovering memory used in displaying.
Close Variable Size Box Data	Deallocates memory used for the current variable box data; the data will no longer be accessible.
Save Configuration Keys	If the current working directory does not have a file named *VIZconfigKeys*, the file is created; if it already exists, the file will be opened for appending. After the file is opened, a complete set of Output Visualizer configuration file keys detailing all of the current settings of the Output Visualizer is written to the file and the file is closed. This feature is necessary to save all of the current Output Visualizer settings in order that the same image can be reproduced at some point in the future.
Reset Configuration Keys	Resets the scale, rotations, and translations to the values previously set the last time the Output Visualizer configuration file keys were set. This is useful for resetting a particular view after a change in the viewing transformations is made without having to read in an Output Visualizer Configuration Key file.
Read Configuration Key File	Reads an Output Visualizer Configuration Key file and redraws the viewing area to reproduce the image settings from the selected file. Refer to the File Formats section for additional information on the Output Visualizer Configuration Key file format. A dialog box is displayed that enables the user to select the file. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Read Batch Command File	Reads and executes commands from an Output Visualizer Batch Command file. Refer to the File Formats section for additional information on the Output Visualizer Batch Command file format. A dialog box is displayed that enables the user to select the file. The batch file is processed—one line at a time—until the file is completed or the `EXIT` batch command is read. The status line is not updated until all batch processing is completed, whereupon the Output Visualizer will return to interactive mode as signified by the "Ready…" status prompt. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.

Menu Option	Description
Save View to File	Saves a TIF image with the dimensions of the viewing window to file in the current working directory if the Current Window Size radio box is selected. If the User Selectable Size radio box is selected, a TIFF image file with the dimensions given in the Image Height and Image Width text boxes will be produced in the current working directory. The addition of the User Selectable Size functionality allows for very large size images to be produced that are not limited by the current screen resolution. They can then be printed to produce large detailed images. The File Name For Image dialog box (Fig. 3) is displayed, which allows the user to enter a name for the file. Enter the desired file name, select the size you want the image to be, and press [OK]. The dialog box will be closed and the status line will return to 'Ready…' when the image has been created. A *.tiff* file extension will be appended to the file name that is set in the File Name text input box. Note: The dialog box should not be moved over the viewing area when [OK] is pressed. The dialog box does not cover the viewing area when the menu item is selected and will not produce a problem unless the dialog box is moved by the user.
Exit	Terminates the Output Visualizer.

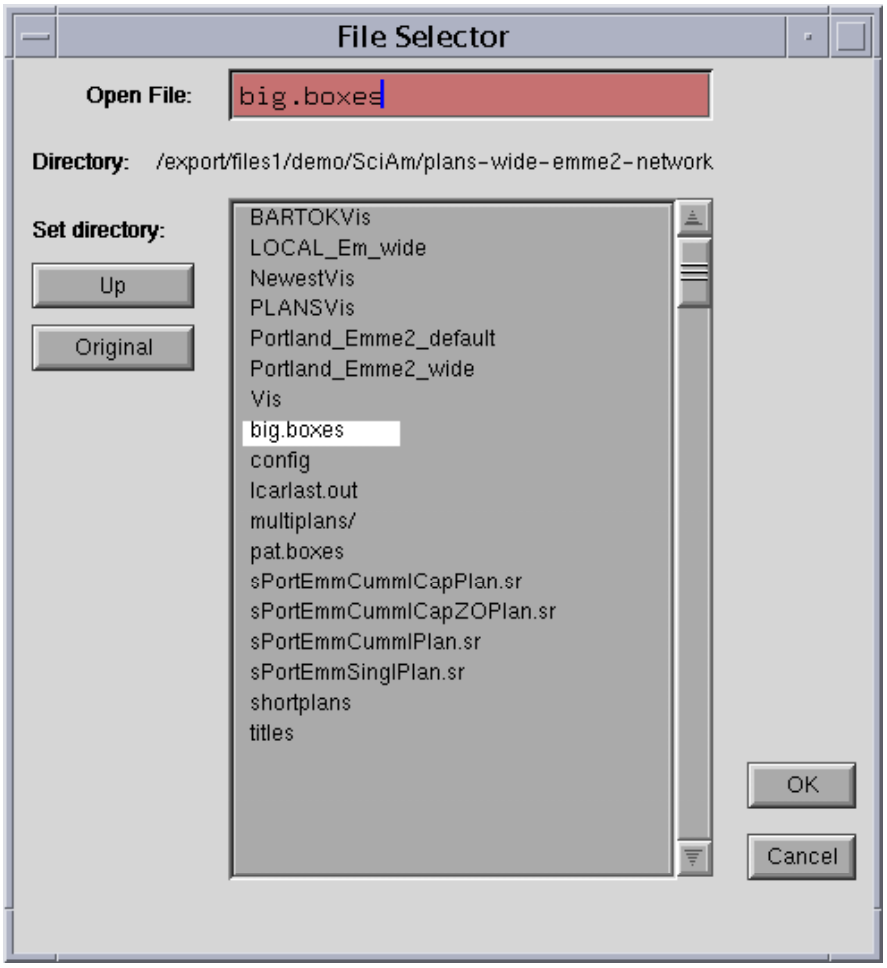

Fig. 2. The File Selector dialog box.

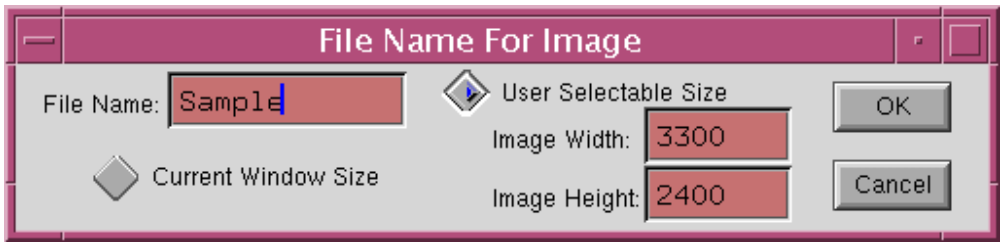

Fig. 3. The File Name For Image dialog box.

2.2.2 Edit Menu

The Edit menu options (Table 4) enable users to find objects, create labels, and change background color.

Table 4. Edit menu functionality.

Menu Option	Description
Add Label	Allows for the setting of a user input text label of a given selectable color at a user-selected point within the current viewing area. This is useful in making transparencies for presentations. The Text Label dialog box is shown in Fig. 4. After clicking [OK] in this dialog box, you will be prompted on the status line to select a location for the lower-left corner of the beginning of the string you have entered with the left-mouse button.
Background Color	Allows the user to change the current background color. The Color Selector dialog box is shown in Fig. 5. Note: The Color Selector dialog box has its own menu; it is used to select primary colors without having to adjust the sliders. Click [OK] to accept the current background color setting that you have selected.
Change All Colormaps	Allows the user to change, all at once, the colormaps used by the Output Visualizer. The File Selector dialog box will be displayed, allowing for the selection of a binary colormaps file. This file is produced with the *mkallbinmaps* utility. Note: Do not double-click on the File Selector; when a directory is selected, the contents of that directory will be displayed.
Find Link	Marks a selected link with an orange “X” and a larger red “X.” The Find Link by ID dialog box (Fig. 6) is displayed , which allows the input of a Link ID to be marked. Enter ‘0’ for the link ID if you do not want to mark a link.

Menu Option	Description
Find Vehicle	Finds a given vehicle by its ID number and colors it in a user-selectable color and a user-selectable point size (when vehicles are displayed as points). This is useful in tracing a single vehicle through the network. The Box Size Fraction numeric input box allows the user to select the size of an area that the chosen vehicle will remain in if the Mode→Follow Vehicle menu option is selected. The value input to the Box Size Fraction input box should be between 0.001 and 0.5. The value is the fraction of the window size from the center of the viewing window that the vehicle may stray from without re-centering the vehicle in the window. The Find Vehicle Parameters dialog box is shown in Fig. 7.
Go To Timestep	Allows for the selection of a user-selected timestep to display. The Go To Timestep dialog box (Fig. 8) is displayed, which allows for the input of a given timestep. The dialog box will not disappear until either a valid timestep is selected or you click [Cancel].
Vehicle Memory Use	Allows for the adjustment of the amount of data kept in memory when an indexed vehicle snapshot file is currently in memory. The Vehicle Memory Usage dialog box (Fig. 9) is displayed, which shows the time range of data currently in memory. It allows for the selection of an initial timestep, a final timestep, and the number of times to increment for the animation (Step Time). Optionally, you may click [Update] to calculate how much memory will be used with the settings currently in the text-input boxes.

Fig. 4. The Text Label dialog box.

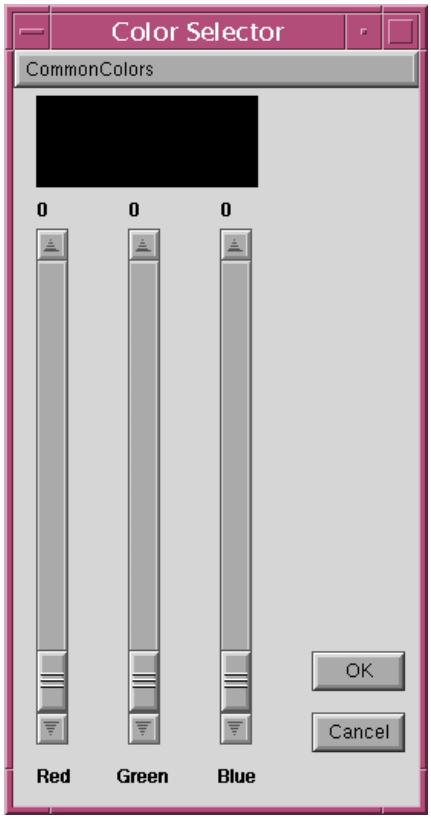

Fig. 5. The Color Selector dialog box.

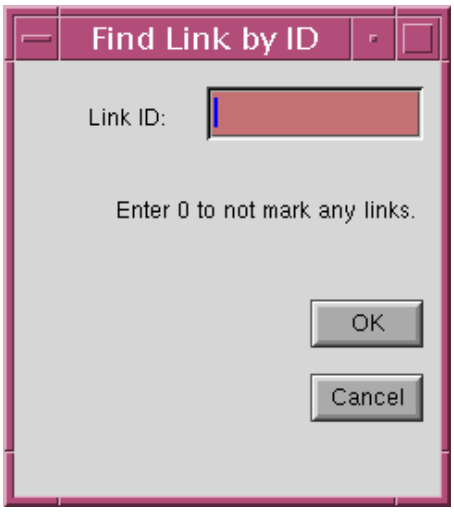

Fig. 6. The Find Link by ID dialog box.

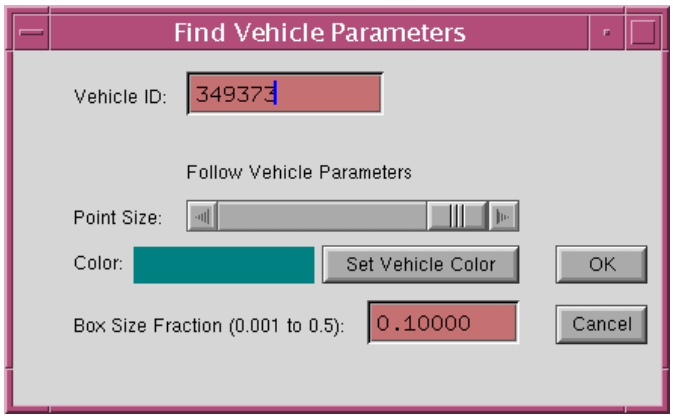

Fig. 7. The Find Vehicle Parameters dialog box.

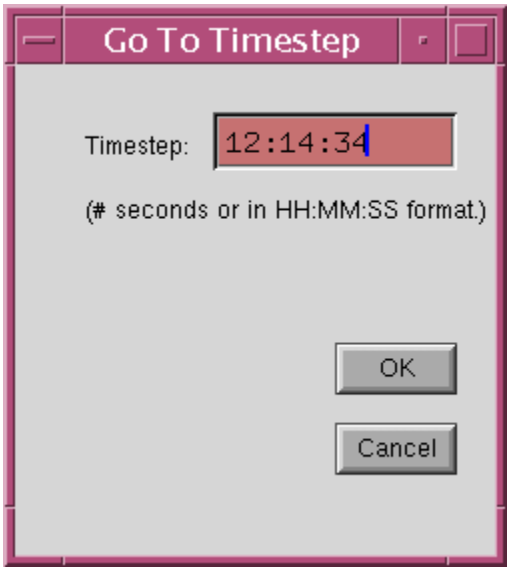

Fig. 8. The Go To Timestep dialog box.

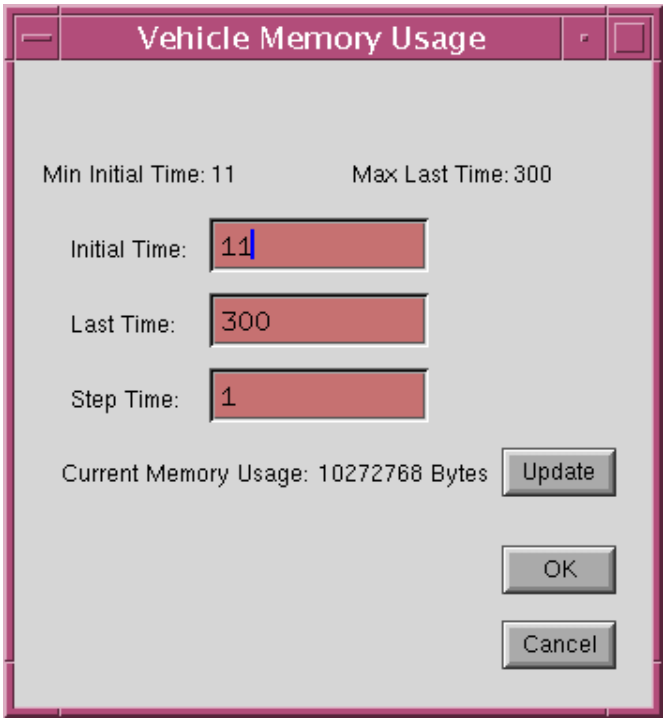

Fig. 9. The Vehicle Memory Usage dialog box.

2.2.3 View Menu

The View menu option (Table 5) enables users to select what type of data they wish to view. It also allows users to select the display style for the data.

Table 5. View menu functionality.

Menu Option	Description
Increment Data Column	Increments the column number to be shown when viewing column-based data including Variable Size Box Data, Link Box Data, Point Data, Network Feature Data, and Polygonal Region Data. This is provided as a more convenient way of looking at column-based data without having to change values in a dialog box.
Labels	Toggles whether labels are drawn.
Lane Dividers	Toggles whether the lane dividers, drawn as dotted lines, will be shown.
Legend	Toggles whether the colormap legend will be shown. Currently, the proper legend will be shown only when non-vehicle data is being displayed.
Link Boxes	Link- and box-based data can be shown as 3-D bar heights or transparency; it can also be mapped to one or two colormaps. This option enables the user to select how he or she would like to view the data in a given column or columns. The data in any given column can be mapped to 3-D bar heights, to transparency, or to a specific color. Selecting the 2 Colormaps option

Menu Option	Description
	allows one column to be represented by mapping the data value from black to another selectable color, and another value to be mapped with a complementary colormap. For example, densities could be mapped with the Black→Red colormap, whereas velocities could be mapped with the RGB: Right→ Left (Blue to Green) colormap. Links where both values are low would be displayed as dark blue and as yellow, where both values are high. The column labels of the current variable size box data file are listed in the Column # - Labels section at the top of the dialog box. The Variable Size Box Data Viewing Parameters dialog box (Fig. 11) is displayed when the View→Link Boxes menu option is selected. The 3-D scale factor is user selectable and determines the heights of the bars for a given numerical value by multiplying the scale factor by the data value. This number should always be a floating-point number. The transparency Min Val setting indicates that all data values falling below this threshold are drawn fully transparent. The transparency Max Val setting indicates that all data values above this threshold are drawn without transparency. Values that lie between are rendered with a proportional degree of transparency. The Min Val settings for the colormap settings indicate that all data values that fall below this number is mapped to the first value in the selected colormap. Likewise, the Max Val settings indicate that all data values above this number is mapped to the last value in the selected colormap.
Link Space Summary Boxes	Link- and box-based data can be shown as 3-D bar heights or transparency; it can also be mapped to one or two colormaps. This option enables the user to select how he or she would like to view the data in a given column or columns. The data in any given column can be mapped to 3-D bar heights, to transparency, or to a specific color. Selecting the 2 Colormaps option allows one column to be represented by mapping the data value from black to another selectable color, and another value to be mapped with a complementary colormap. For example, densities could be mapped with the Black→Red colormap, whereas velocities could be mapped with the RGB: Right→Left (Blue to Green) colormap. Links where both values are low would be displayed as dark blue and as yellow where both values are high. The column labels of the current variable size box data file are listed in the Column # - Labels section at th etop of the dialog box. The Variable Size Box Data Viewing Parameters dialog box (Fig. 11) is displayed when the View→Link Space Summary Boxes menu option is selected.

Menu Option	Description
	The 3-D scale factor is user selectable and determines the heights of the bars for a given numerical value by multiplying the scale factor by the data value. This number should always be a floating-point number. The transparency Min Val setting indicates that all data values falling below this threshold are drawn fully transparent. The transparency Max Val setting indicates that all data values above this threshold are drawn without transparency. Values that lie between are rendered with a proportional degree of transparency. The Min Val settings for the colormap settings indicate that all data values that fall below this number are mapped to the first value in the selected colormap. Likewise, the Max Val settings indicate that all data values above this number are mapped to the last value in the selected colormap.
Network	Allows for setting the current network viewing options. The Network Viewing Parameters dialog box (Fig. 10) is displayed. Clicking on the check boxes enables the user to select whether to display the Activity Locations, Barriers, Detectors, Nodes, Transit Stops, Parking Accessories, Links, and Boxes. Checked boxes indicate that the item will be displayed. The point size can be altered when viewing the Activity Locations, Barriers, Detectors, Nodes, Transit Stops, and Parking Accessories. All colors are user selectable and may be changed by clicking the appropriate Set Color buttons. Click [OK] when the viewing options are set to your liking.
Network Features	Geographic point-based data can be shown as 3-D bar heights or transparency; it can also be mapped to one or two colormaps. This option enables the user to select how he or she would like to view the data in a given column or columns. The data in any given column can be mapped to 3-D bar heights, to transparency, or to a specific color. Selecting the 2 Colormaps option allows one column to be represented by mapping the data value from black to another selectable color, and another value to be mapped with a complementary colormap. For example, densities could be mapped with the Black→Red colormap, whereas velocities could be mapped with the RGB: Right→Left (Blue to Green) colormap. Links where both values are low would be displayed as dark blue and as yellow where both values are high. The column labels of the current variable size box data fire are listed in the Column # - Labels section at the top of the dialog box. The Network Feature & Point Data Viewing Parameters dialog box (Fig. 12) is displayed when the View→Network Features menu option is selected.

Menu Option	Description
	The geographic point data can be plotted in nine different user-selectable ways, including: • Plot at Source – plots data at the first location given in a data record. • Plot at Current Loc – plots data at the second location in a data record. • Plot at Destination – plots data at the third location in a data record. • Plot at Source & Curr – plots data at the first and second locations given in a data record. • Plot at Current & Dest – plots data at the second and third locations in a data record. • Plot at Source & Dest – plots data at the first and third locations in a data record. • Connect Src & Curr – plots data as a line connecting the first and second locations given in a data record. • Connect Curr & Dest – plots data as a line connecting the second and third locations in a data record. • Connect Src & Dest – plots data as a line connecting the first and third locations in a data record. If Selection areas are defined in the data file, subsets of the data can be shown based on whether a given location falls inside or outside of a user-selected area. The location to test whether it falls in the area selected can be chosen with the Src, Curr, and Dest radio buttons. Whether to test if the location is inside or outside of the area is selected with the Inside Area Radio button. If the button is checked (it will turn yellow), the currently selected location will be checked to determine that it falls within the currently selected area; and if it falls within the currently selected area, the record will not be drawn. Cones, rather than extruded boxes, may be drawn at the specific locations using the data by selecting the Base Width and Peak Width radio buttons and entering their respective scale factors. If the Base Width radio button is not selected, the width of the base will be the number entered into the Base Width Scale Factor text box. The width of the peaks will be the number entered into the Peak Width Scale Factor text box if the Peak Width radio button is unchecked. If the Base Width radio button is checked, the width of the base will be calculated by multiplying the data value in the currently selected column by the Scale Factor. The 3D Bars scale factor is user selectable and determines the heights of the bars for a given numerical value by multiplying the scale factor by the data value. This number should always be a floating-point number. The transparency Min Val setting indicates that all data values falling below this threshold are drawn fully transparent. The transparency Max Val setting indicates that all data values above this threshold are drawn

Menu Option	Description
	without transparency. Values that lie between are rendered with a proportional degree of transparency. The Min Val setting for the colormap settings indicate that all data values that fall below this number are mapped to the first value in the selected colormap. Likewise, the Max Val settings indicate that all data values above this number are mapped to the last value in the selected colormap.
Point Data	Geographic point-based data can be shown as 3-D bar heights or transparency; it can also be mapped to one or two colormaps. This option enables the user to select how he or she would like to view the data in a given column or columns. The data in any given column can be mapped to 3-D bar heights, to transparency, or to a specific color. Selecting the 2 Colormaps option allows one column to be represented by mapping the data value from black to another selectable color, and another value to be mapped with a complementary colormap. For example, densities could be mapped with the Black→Red colormap, whereas velocities could be mapped with the RGB: Right→Left (Blue to Green) colormap. Links where both values are low would be displayed as dark blue, and as yellow where both values are high. The column labels of the current variable size box data file are listed in the Column # - Labels section at the top of the dialog box. The Network Feature & Point Data Viewing Parameters dialog box (Fig. 12) is displayed when the View→Network Features menu option is selected. The geographic point data can be plotted in nine different user selectable ways including: • Plot at Source – plots data at the first location given in a data record. • Plot at Current Loc – plots data at the second location in a data record. • Plot at Destination – plots data at the third location in a data record. • Plot at Source & Curr – plots data at the first and second locations given in a data record. • Plot at Current & Dest – plots data at the second and third locations in a data record. • Plot at Source & Dest – plots data at the first and third locations in a data record. • Connect Src & Curr – plots data as a line connecting the first and second locations given in a data record. • Connect Curr & Dest – plots data as a line connecting the second and third locations in a data record. • Connect Src & Dest – plots data as a line connecting the first and third locations in a data record.

Menu Option	Description
	If the selection areas are defined in the data file, subsets of the data can be shown based on whether a given location falls inside or outside of a user-selected area. The location to test whether it falls in the area selected can be chosen with the Src, Curr, and Dest radio buttons. Whether to test if the location is inside or outside of the area is selected with the Inside Area Radio button. If the button is checked (it will turn yellow), the currently selected location will be checked to determine that it falls within the currently selected area, and if it falls within the area, the record will be drawn; if it is found not to be within the currently selected area the record will not be drawn. Cones, rather than extruded boxes, may be drawn at the specific locations using the data by selecting the Base Width and Peak Width radio buttons and entering their respective scale factors. If the Base Width radio button is not selected, the width of the base will be the number entered into the Base Width Scale Factor text box. The width of the peaks will be the number entered into the Peak Width Scale Factor text box if the Peak Width radio button is unchecked. If the Base Width radio button is checked, the width of the base will be calculated by multiplying the data value in the currently selected column by the Scale Factor. The 3D Bars scale factor is user selectable and determines the heights of the bars for a given numerical value by multiplying the scale factor by the data value. This number should always be a floating-point number. The transparency Min Val setting indicates that all data values falling below this threshold are drawn fully transparent. The transparency Max Val setting indicates that all data values above this threshold are drawn without transparency. Values that lie between are rendered with a proportional degree of transparency. The Min Val settings for the colormap settings indicate that all data values that fall below this number are mapped to the first value in the selected colormap. Likewise, the Max Val settings indicate that all data values above this number are mapped to the last value in the selected colormap.
Polygonal Region Data	Polygonal region-based data can be shown as 3-D bar heights or transparency; it can also be mapped to one or two colormaps. This option enables the user to select how he or she would like to view the data in a given column(s). The data in any given column can be mapped to 3-D bar heights, to transparency, or to a specific color. Selecting the 2 Colormaps option allows one column to be represented by mapping the data value from black to another selectable color, and another value to be mapped with a complementary colormap. For example, densities could be mapped

Menu Option	Description
	with the Black→Red colormap, whereas velocities could be mapped with the RGB: Right→Left (Blue to Green) colormap. Regions where both values are low would be displayed as dark blue; regions where both values are high would be displayed as yellow. The column labels of the current variable size box data file are listed in the Column # - Labels section at the top of the dialog box. The Network Feature & Point Data Viewing Parameters dialog box (Fig. 12) is displayed when the View→Polygonal Region menu option is selected. Items that control the Base and Peak width for the Point Data and Network Feature Data are not displayed when this menu item is chosen. The polygonal region data can be plotted in three different user-selectable ways including: • Plot at Source – plots data at the first location given in a data record. • Plot at Current Loc – plots data at the second location in a data record. • Plot at Destination – plots data at the third location in a data record. The polygonal regions can also be used as selection areas. It is then possible to view subsets of the data to selectively show data based on whether its source, current, or destination region is within a given region or is not in a given region. For example, you could display all of the data whose source region is in the downtown area. The region to test whether it falls in the area selected can be chosen with the Src, Curr, and Dest radio buttons. Whether to test if the region is inside or outside of the area is selected with the Inside Area Radio button. If the button is checked (it will turn yellow), the currently selected location will be checked to determine that it falls within the currently selected area; and if it falls within the area, the record will be drawn. If it is found not to be within the currently selected area, the record will not be drawn. The 3D Bars scale factor is user selectable and determines the heights of the bars for a given numerical value by multiplying the scale factor by the data value. This number should always be a floating-point number. The transparency Min Val setting indicates that all data values falling below this threshold are drawn fully transparent. The transparency Max Val setting indicates that all data values above this threshold are drawn without transparency. Values that lie between are rendered with a proportional degree of transparency. The Min Val settings for the colormap settings indicate that all data values that fall below this number are mapped to the first value in the

Menu Option	Description
	selected colormap. Likewise, the Max Val settings indicate that all data values above this number are mapped to the last value in the selected colormap. It is possible to have stacked regions with this type of display because you may have multiple data entries for a given region. See Fig. 13 for an example Polygonal Region data display.
Variable Size Boxes	Link- and box-based data can be shown as 3-D bar heights or transparency; it can also be mapped to one or two colormaps. This option enables the user to select how he or she would like to view the data in a given column or columns. The data in any given column can be mapped to 3-D bar heights, to transparency, or to a specific color. Selecting the 2 Colormaps option allows one column to be represented by mapping the data value from black to another selectable color, and another value to be mapped with a complementary colormap. For example, densities could be mapped with the Black->Red colormap, whereas velocities could be mapped with the RGB: Right->Left (Blue to Green) colormap. Links where both values are low would be displayed as dark blue and as yellow where both values are high. The column labels of the current variable size box data file are listed in the Column # - Labels section at the top of the dialog box. The Variable Size Box Data Viewing Parameters dialog box (Fig. 11) is displayed when the View→Variable Size Boxes menu option is selected. The 3-D scale factor is user selectable and determines the heights of the bars for a given numerical value by multiplying the scale factor by the data value. This number should always be a floating-point number. The transparency Min Val setting indicates that all data values falling below this threshold are drawn fully transparent. The transparency Max Val setting indicates that all data values above this threshold are drawn without transparency. Values that lie between are rendered with a proportional degree of transparency. The Min Val settings for the colormap settings indicate that all data values that fall below this number are mapped to the first value in the selected colormap. Likewise, the Max Val settings indicate that all data values above this number are mapped to the last value in the selected colormap.
Vehicles	Allows for setting the current vehicle viewing options. Fig. 14 shows the Vehicle Viewing Parameters dialog box. Clicking on the check boxes enables the user to color the vehicles. Each mode is discussed below: • The *Same Color Mode* colors all of the vehicles in the same user-

Menu Option	Description
	selectable color. • The *Color by Type Mode* colors vehicles according to their vehicle type and also renders buses larger than standard vehicle types. Buses are rendered in orange, with the rear section rendered in purple (according to how many passengers are currently aboard the bus). • The *Color by Passengers Mode* colors vehicles according to the number of passengers in the vehicle by a given colormap that is user selectable. • The *Color by Velocity Mode* colors vehicles according to their current velocity by a given colormap that is user selectable. • The *Color by User Field Mode* colors vehicles according to their current user field data value by a given colormap that is user selectable. The minimum and maximum values to use for the colormap are also user selectable. • The *Color by Random Colors Mode* colors vehicles according to their vehicle ID by a range of colors. Vehicles often are too small to be seen at lesser scales; at these lesser scales the vehicles will be drawn as points. The point size for vehicles is user selectable with the use of the Point Size slider. Vehicles are drawn in three dimensions if the 3-D Vehicles radio box is checked (it will turn yellow when it is checked). Click [OK] when you are satisfied with the current vehicle-coloring mode.

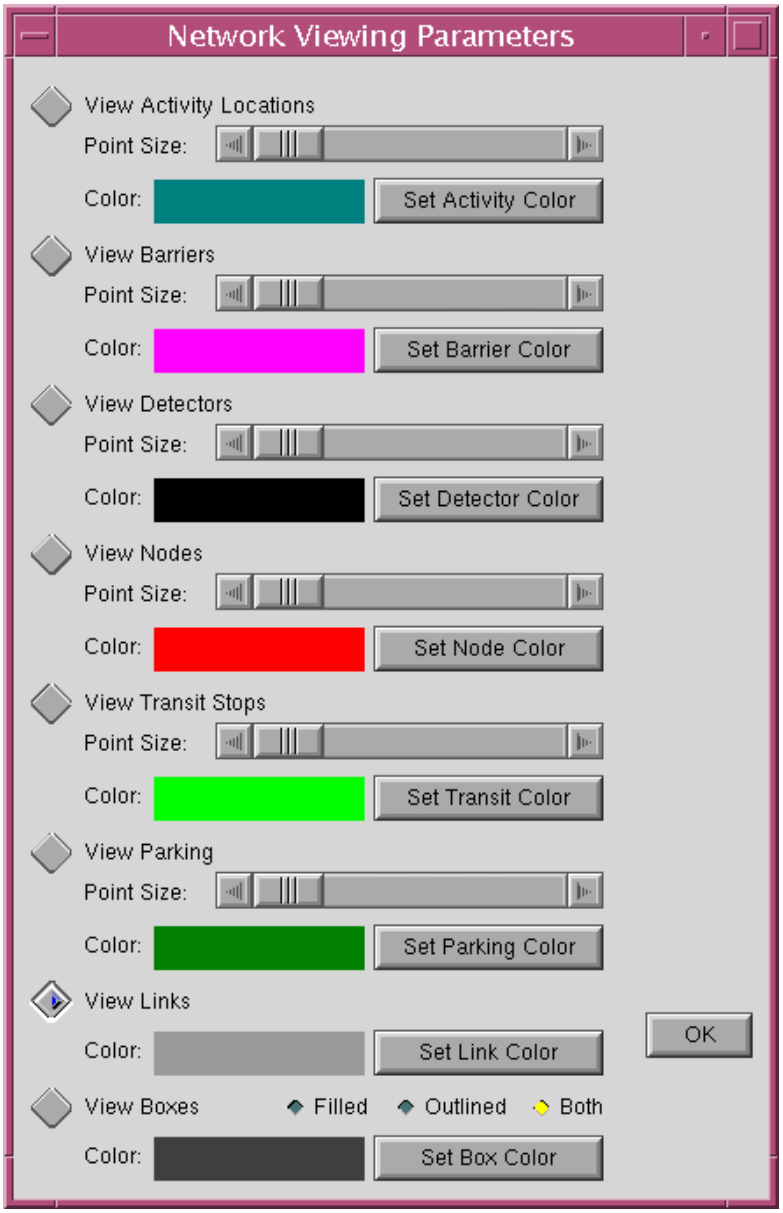

Fig. 10. The Network Viewing Parameters dialog box.

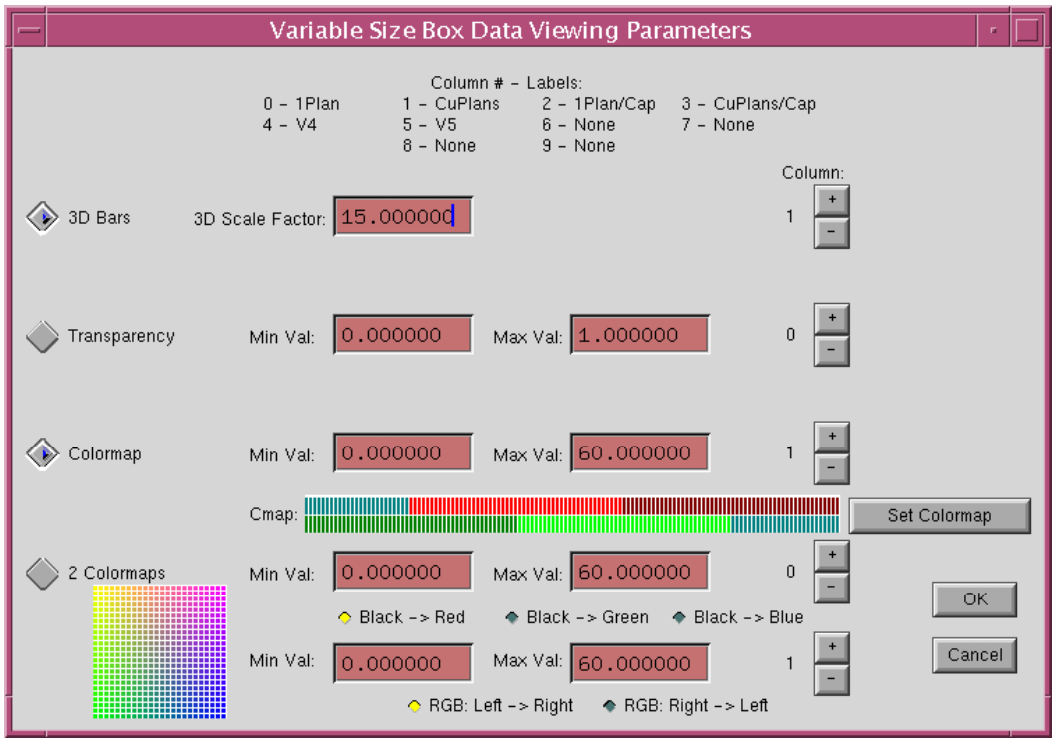

Fig. 11. The Variable Size Box Data Viewing Parameters dialog box.

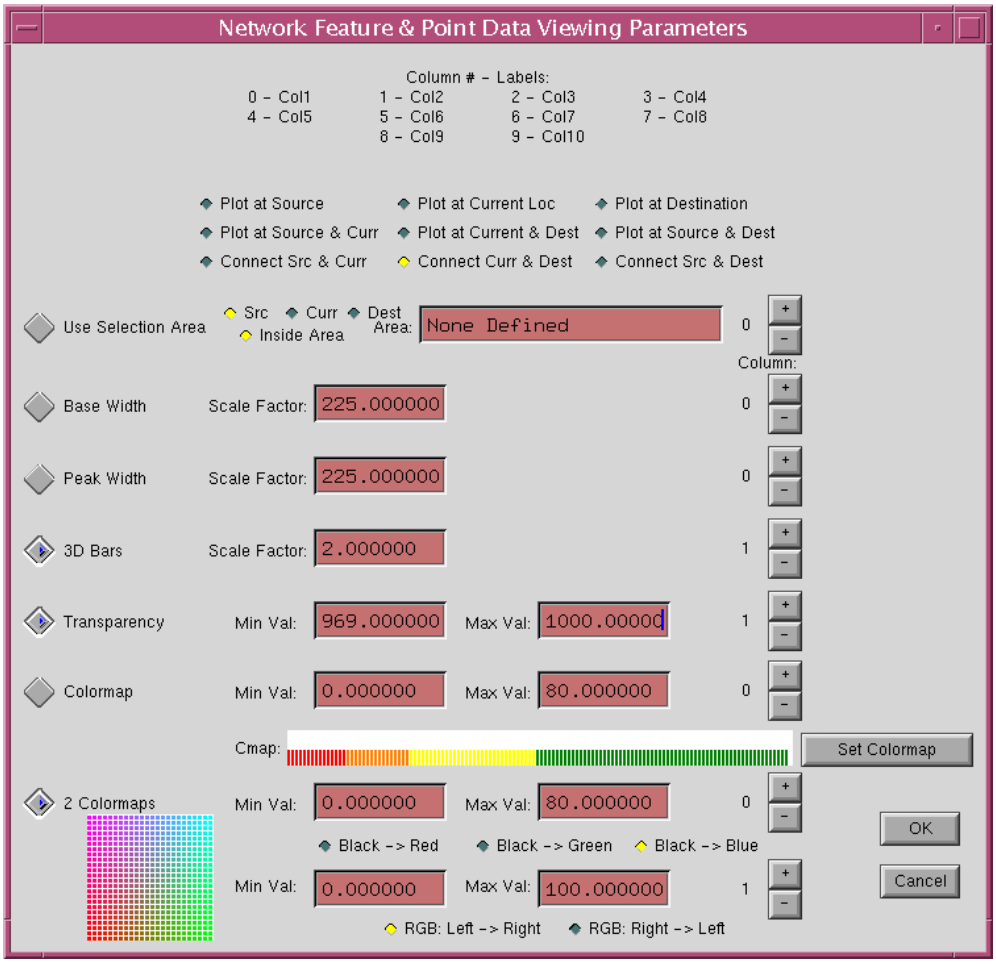

Fig. 12. The Network Feature & Point Data Viewing Parameters dialog box.

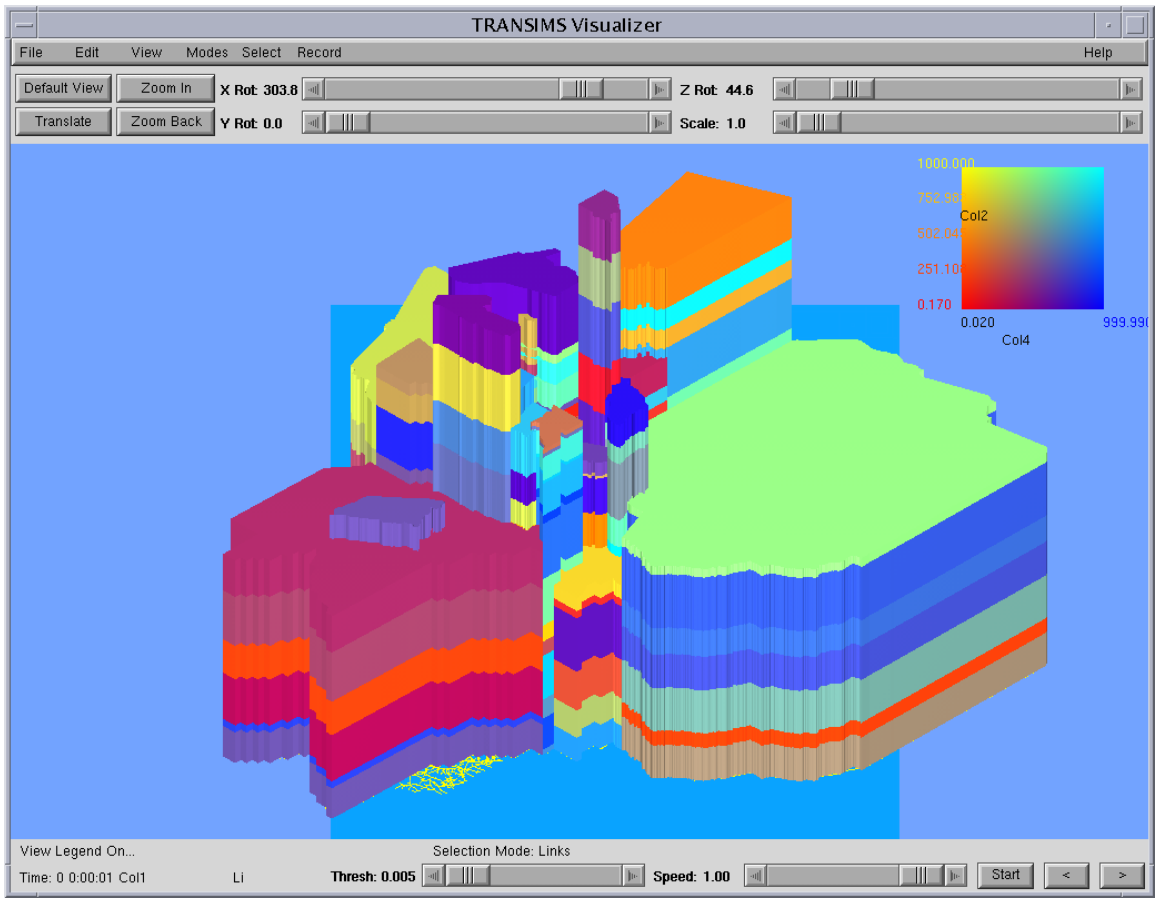

Fig. 13. Polygonal Region data display.

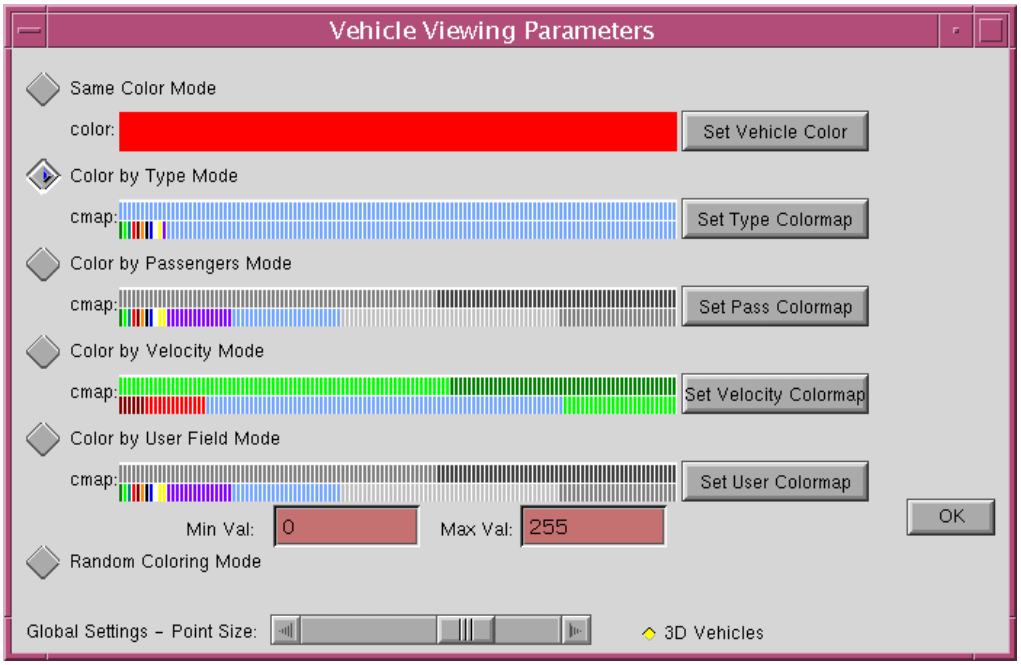

Fig. 14. The Vehicle Viewing Parameters dialog box.

2.2.4 Modes Menu

The Modes menu option (Table 6) enables users to select various modes, such as whether to use the lighting model, overlay mode, 3-D or 2-D network, etc.

Table 6. Modes menu functionality.

Menu Option	Description
3-D Network	Toggles whether the z-axis values are used when drawing the network. This is useful because the user may want to display the topography of the network at times and not display the topography when drawing 3-D boxes (and thus the boxes are compared more easily). When the 3D Network mode is `on`, a 3DNet label is displayed between the 'Time:' text label and the 'Thresh:' slider.
Follow Vehicle	Translates the current view (if necessary), making sure that the vehicle chosen with the Edit→Find Vehicle menu option is always visible. Note: Currently, the Follow Vehicle mode does not work properly when rotated viewing angles (non-zero) are selected.
Lights On/Off	Toggles the lighting model `on` and `off`. When viewing in 3-D mode, the lights are switched on to correctly render the faces of 3-D polygons. Without the lighting model switched on, all of the sides of a box will be drawn in the exact same color. Therefore, the user cannot distinguish the separate faces on the box. When the Lighting Model is `on`, the Li label is displayed between the 'Time:' text label and the 'Thresh:' slider.

Menu Option	Description
Overlay On/Off	Toggles whether the overlay mode is `on` or `off`. If overlay mode is `on`, the network is not redrawn for each frame and the pixels of the viewing area are transferred from an area in memory, which was saved after the network was drawn with the current viewing transformations. This saves a large amount of time in drawing complex scenes and makes high-frame-rate animation possible. When the Overlay mode is `on`, an Ov label is displayed between the 'Time:' text label and the 'Thresh:' slider. It is usually faster to draw small networks than to move the pixels with overlay mode. Therefore, this mode is used only with larger networks (approximately 3,000 links or more).
Ride in Vehicle	Toggles the viewpoint from the default viewpoint above the network and centered to the viewpoint from within the currently selected vehicle as set from the Edit→Find Vehicle menu option. A warning message is displayed if the selected vehicle ID is not present in any of the data currently loaded on the status line. In most cases, the selected vehicle ID will not be present in all of the timesteps of the currently loaded data. This is handled in several ways: • If the vehicle does not appear in the first timestep of the currently loaded data, the viewpoint is set to where the vehicle first appears in the data. • If the vehicle does not appear in the last timestep of the currently loaded data, the viewpoint is set to where the vehicle last appears in the data. • If the vehicle does not appear in a given timestep (where it appears in both previous and subsequent timesteps), the most previous viewpoint will be kept. This happens frequently when vehicles are in intersection queues. • The sliders above the viewing area are also relabeled in this mode to Roll, Pitch, Yaw, and Height. The buttons above the viewing area should not be used in this mode; results are undefined if they are used.

2.2.5 Select Menu

The Select menu option (Table 7) enables the user to select which type of object will be searched for when the middle mouse button is clicked in the viewing area. A special measurement mode can also be selected from this menu.

Table 7. Select menu functionality.

Menu Option	Description
Activity Locations	Looks for the nearest activity location when the middle mouse button is clicked in the viewing area. You must click within 150 units of both the x and y location for an activity location to be found. If there is more than one activity location within the 150 unit constraint, information on the nearest activity location is displayed. A warning message is displayed if there is not an activity location within the 150 unit constraint.
Detectors	Looks for the nearest detector when the middle mouse button is clicked in the viewing area. You must click within 150 units of both the x and y location for a detector to be found. If there is more than one detector within the 150-unit constraint, information on the nearest detector is displayed. A warning message is displayed if there is not a detector location within the 150-unit constraint.
Intersection Queues	Looks for the intersection queue data when the middle mouse button is clicked in the viewing area. You must click on a link near a node where there is intersection data for the queue data to be displayed. A warning message is displayed if there are no queue data or if you have not clicked on a link.
Links and Nodes	Looks for the link ID when the middle mouse button is clicked in the viewing area. You must click on a link for the link data to be displayed. A warning message is displayed if you have not clicked on a link. Note: The link you attempt to select must be visible as a polygon for you to select it. Use the scale slider to zoom in if you are unable to select the link because it is too thin.
Measurement	Returns the distances between the down click and the release of the middle mouse button. The three-dimensional distance will be displayed, as well as the changes in the x, y, and z coordinates.
Parking Acc.	Looks for the nearest parking accessory when the middle mouse button is clicked in the viewing area. You must click within 150 units of both the x and y location for a parking accessory to be found. If there is more than one parking accessory within the 150-unit constraint, information on the nearest parking accessory is displayed. A warning message is displayed if there is not a parking accessory within the 150-unit constraint.
Transit Stops	Looks for the nearest transit stop when the middle mouse button is clicked in the viewing area. You must click within 150 units of both the x and y location for a transit stop to be found. If there is more than one transit stop within the 150-unit constraint, information on the nearest transit stop is displayed. A warning message is displayed if there is not a transit stop within the 150-unit constraint.

Menu Option	Description
Vehicles	Looks for the vehicle when the middle mouse button is clicked in the viewing area. If the vehicles are displayed as points, you must click within five scaled meters of the vehicle location to return valid data. If the vehicles are represented as polygons, you must click inside the triangle area in the front of the vehicle (this is the entire area of the vehicle except for buses, which have a rectangular back end). A warning message is displayed if there is no vehicle present where you have clicked the middle mouse button.

2.2.6 Record Menu

The Record menu option (Table 8) enables the user to select various resolutions to save animated sequences. It displays a Recording Control dialog box (Fig. 15) to facilitate the control of saving animated sequences to files.

Table 8. Record menu functionality.

Option	Description
NTSC Sequences	Sets the viewing area to an NTSC (National Television Standards Committee) -compatible 720 x 486 pixels. It also displays a Recording Control dialog box(Fig. 15), which enables the user to select start and end frames with the total number of frames to save to a sequence of Sun Raster files. The Recording Control dialog box also enables users to reverse any of the standard directions of rotation and allows for previewing of the user-set sequence. Click [Done] to close the recording control box. Resize the window to reset the viewing area to its standard size.
PAL Sequences	Sets the viewing area to a PAL (Phase Alternating Line) -compatible 720 x 576 pixels. It also displays the Recording Control dialog box (Fig. 15), which enables the user to select start and end frames with the total number of frames to save to a sequence of Sun Raster files. The Recording Control dialog box enables users to reverse any of the standard directions of rotation and allows for previewing of the user-set sequence. Click [Done] to close the recording control box. Resize the window to reset the viewing area to its standard size.
16 x 9 NTSC Sequences	Sets the viewing area to a 16 x 9 NTSC-compatible 864 x 486 pixels. It also displays the Recording Control dialog box (Fig. 15), which enables the user to select start and end frames with the total number of frames to save to a sequence of Sun Raster files. The Recording Control dialog box enables users to reverse any of the standard directions of rotation and allows for previewing of the user-set sequence. Click [Done]]to close the recording control box. Resize the window to reset the viewing area to its standard size.

Option	Description
16 x 9 PAL Sequences	Sets the viewing area to a 16 x 9 PAL-compatible 1024 x 576 pixels. It also displays the Recording Control dialog box (Fig. 15), which enables the user to select start and end frames with the total number of frames to save to a sequence of Sun Raster files. The Recording Control dialog box also enables users to reverse any of the standard directions of rotation and allows for previewing of the user-set sequence. Click [Done] to close the recording control box. Resize the window to reset the viewing area to its standard size.
640 x 480 Sequences	Sets the viewing area to a 640 x 480 pixel resolution. This size is useful for producing QuickTime or AVI movies. It also displays the Recording Control dialog box (Fig. 15), which enables the user to select start and end frames with the total number of frames to save to a sequence of Sun Raster files. The Recording Control dialog box also enables users to reverse any of the standard directions of rotation and allows for previewing of the user-set sequence. Click [Done] to close the recording control box. Resize the window to reset the viewing area to its standard size.
Current Size Sequences	Does not reset the current size of the viewing area. It displays the Recording Control dialog box (Fig. 15), which enables the user to select start and end frames with the total number of frames to save to a sequence of Sun Raster files. The Recording Control dialog box also enables users to reverse any of the standard directions of rotation and allows for previewing of the user-set sequence. Click [Done] to close the recording control box. Resize the window to reset the viewing area to its standard size.

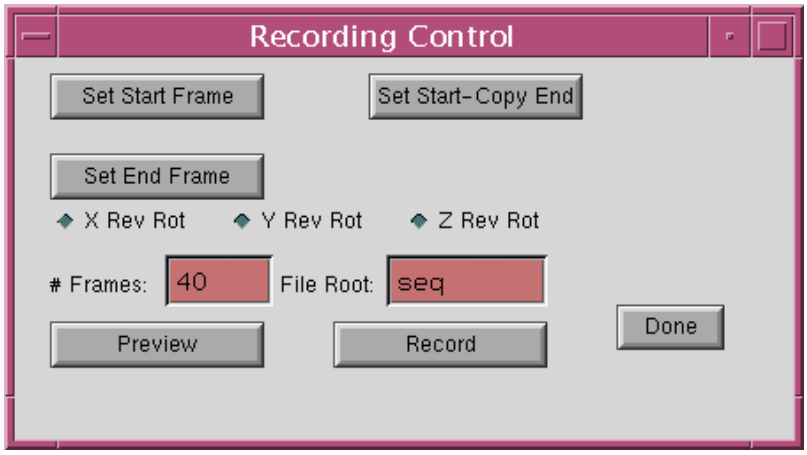

Fig. 15. The Recording Control dialog box.

2.2.7 Help Menu

The Help menu option (Table 9) is reserved for future use in implementing a help facility. Without the help menu, odd behavior occurs when accessing the menu system.

Table 9. Help menu functionality.

Menu Option	Description
Index	An index into the help topics. **Not implemented at this time**.
Search	Allows for searching for keywords in the help system. **Not implemented at this time.**
About	Displays a dialog box about the current version of the Output Visualizer. **Not implemented at this time.**

2.3 Troubleshooting

Potential Output Visualizer problems and their solutions are outlined in Table 10.

Table 10. Troubleshooting the Output Visualizer.

1	Problem	The Output Visualizer is not working. It returns something like the following error message: X Error of failed request: BadMatch (invalid parameter attributes) Major opcode of failed request: 1 (X_Create_Window) Serial number of failed request: 21 Current serial number in output stream: 23
	Solution	A part of the X server is functioning improperly. Therefore, logout and login again to solve the problem. To date, this problem has occurred only on Sun Workstations with Solaris.
2	Problem	A menu appears when I clicked on something else.
	Solution	This problem is thought to be fixed, but since thorough testing is impossible, it may occur nevertheless. The problem is not disastrous in nature. Simply click on the menu bar where a menu is not located. This should take care of the problem within a few mouse clicks.
3	Problem	I am using the Record menu option and the user interface area is damaged and needs to be redrawn. However, it is not getting redrawn.
	Solution	This problem is caused by a known problem in the GLUT library in versions prior to 3.7.3. If you are running under an older version of GLUT, please upgrade to at least version 3.7.3. If you cannot upgrade to a newer version of GLUT at the time the problem occurs, you will need to record a sequence then exit and restart the Output Visualizer to record each subsequent sequence. Alternatively, a Visualizer Batch Command file could be used to create the images.
4	Problem	I try to select a vehicle or intersection queue or link, but I keep getting the following message: ERROR: Object not found.
	Solution	This problem is caused by the way the selection is performed. You must click inside the polygonal region of the object for the object to be found. At lesser scales, the objects are less than the thickness of a pixel and, therefore, they cannot be selected by this method. The solution is to use the scale slider to enlarge the object, and then to select the object again.
5	Problem	The network disappears when Overlay Mode is on and the Lights are on.

	Solution	This problem is caused by an OpenGL routine that is not guaranteed to succeed. It is very dependent on the current rotation. Try rotating the image a little more or less and the network should reappear. If you need to see the network at a certain orientation and the network does not appear, switch off the Overlay mode.
6	Problem	The display is very slow.
	Solution	Make sure you have taken advantage of the hardware acceleration available on your machine. In particular, make sure you are using the drivers and OpenGL libraries supplied by the manufacturer of your graphics board. Next, make sure you have compiled the Output Visualizer on the machine on which you are running or on a machine with the same operating system and the same graphics board as the machine on which you are running. With very large networks, the frame rate can drop to about one-to-two frames per second even with the best of hardware. In this situation, it is sometimes preferable to not render the network at all times. Switch off the Network with the View – Network menu selection, perform the analysis you can do without the network, and switch the network back on when it is needed.
7	Problem	The legend is partially/completely obscured by the image.
	Solution	At this time, there is no solution; however, it can be minimized by setting a small scale and by translating the image to the left.

3. VISUALIZATION FILES

3.1 Input Files

3.1.1 Variable Size Box Format

Fields in the variable size box format are tab-delimited. Each line of the variable size box format contains at least six mandatory fields:

1) Time
2) Link ID
3) Node ID
4) Distance (the distance where the described box ends from the beginning of the link at Node ID)
5) Length (the total length of the box being described)
6) Data Value

Moreover, it is possible to add up to nine more data-value columns. We suggest that you provide a labeling line on the first line of the file. This line should describe each column (as shown below):

```
TIME LINK NODE DISTANCE LENGTH DataVal1 DataVal2 DataVal3 DataVal4... DataVal10
```

Format:

```
<TIME> <Link ID> <Node ID> <Distance> <Length> <Data Value 1> [<Data Value 2> … <Data Value 10>]
```

Example:

```
TIME  LINK  NODE  DISTANCE  LENGTH  DataVal1  DataVal2  DataVal3
800   1400  1256  24.75     12.50   10.2      0.4       35.6
```

At time 800 of the simulation, a box is drawn of length 12.5 that ends 24.75 meters from node 1256 of link 1400. The data values for each of the first three columns are 10.0, 20.4, and 35.6, respectively.

3.1.2 Indexed Binary Vehicle Snapshot Format

Table 11 lists the data structure fields for each vehicle record. The output file can be converted with the *indexvehtobin* utility. The usage of the *indexvehtobin* command is as follows:

```
indexvehtobin inputfilename outputfilename
```

Table 11. Indexed Binary Vehicle Snapshot format data structure fields.

Field	Description	Allowed Values
`Status`	The vehicle type number in the lower 8 bits and number of passengers in the upper 8 bits.	Integer (16 bits)
`Theta`	The number of degrees from due east in which the vehicle is pointed. The angle is calculated counterclockwise from due east.	Integer (16 bits)
`User`	A user settable field.	Integer (32 bits)
`Time`	The current simulation time for which this current record has been collected.	Integer (32 bits)
`Velocity`	The current vehicle velocity.	Decimal (32 bits)
`X`	The current *x* position of the front middle of the vehicle.	Decimal (32 bits)
`Y`	The current *y* position of the front middle of the vehicle.	Decimal (32 bits)
`Z`	The current *z* position of the front middle of the vehicle.	Decimal (32 bits)
`Vehicle ID`	The vehicle ID.	Integer (32 bits)
`Link ID`	The current link ID on which the vehicle is traveling.	Integer (32 bit)

File Header:

`f` = one character lowercase f to signify a file header

= the number of timesteps in this file (a 64-bit integer)

Time Header:

`t` = one character lowercase t to signify a timestep header

= the timestep (a 32-bit integer)

= the number of data records in this timestep (a 64-bit integer)

3.1.3 Network Feature Evolution Format

Fields in the Network Feature Evolution format are tab-delimited. Each line of the variable size box format contains at least six mandatory fields:

1) Time
2) Feature Type
3) Feature ID #1 (Source)
4) Feature ID #2 (Current Location)

5) Feature ID #3 (Destination)

6) Data value

It is also possible to add up to nine more data-value columns. We suggest that you provide a labeling line on the first line of the file. This line should describe each column (as shown below)

```
TIME FETYPE FEID1 FEID2 FEID3 DataVal1 DataVal2 DataVal3 DataVal4… DataVal10
```

Format:

```
<TIME> <FETYPE> <FEID1> <FEID2> <FEID3> <Data Value 1> [<Data Value 2> … <Data Value 10>]
```

Note: It is also possible to take advantage of the area selection capabilities by defining polygonal regions at the start of the file. The format for these polygonal regions is described in the Polygonal Region Data Format. The polygonal regions must have a header of `POLYS` alone on one line to start the data.

FETYPE field is:

`p` = parking lots

`t` = transit stops

`b` = barriers

`n` = nodes

`a` = activity locations

`d` = detectors

Example:

```
TIME  FETYPE  FEID1`  FEID2  FEID3  DataVal1  DataVal2
800   p       200     400    300    5.0       25.9
800   5       300     321    256    8.4       23.5
```

3.1.4 Link Evolution Format

Fields in the Link Evolution format are tab-delimited. Each line of the variable size box format contains at least five mandatory fields:

1) Time

2) Link

3) Node

4) Lane

5) Data value

It is also possible to add up to nine more data-value columns. We suggest that you provide a labeling line on the first line of the file. This line should describe each column (as shown below)

```
TIME LINK NODE LANE DataVal1 DataVal2 DataVal3 DataVal4… DataVal10
```

Format:

```
<TIME> <LINK> <NODE> <LANE> <Data Value 1> [<Data Value 2> … <Data Value 10>]
```

The `LANE` field is –1 for all lanes; otherwise, it is the lane number.

Example:

```
TIME  LANE  NODE  LANE  DataVal1  DataVal2
800   200   400   -1    5.0       25.9
800   300   321    2    8.4       23.5
```

3.1.5 Arbitrary Point Evolution Format

Fields in the Arbitrary Point Evolution format are tab-delimited. Each line of the variable size box format contains at least eleven mandatory fields:

1) Time
2) Point X Value (Source Location)
3) Point Y Value (Source Location)
4) Point Z Value (Source Location)
5) Point X Value (Current Location)
6) Point Y Value (Current Location)
7) Point Z Value (Current Location)
8) Point X Value (Destination Location)
9) Point Y Value (Destination Location)
10) Point Z Value (Destination Location)
11) Data value

It is also possible to add up to nine more data-value columns. We suggest that you provide a labeling line on the first line of the file. This line should describe each column (as shown below)

```
TIME Xsrc Ysrc Zsrc Xcurr Ycurr Zcurr Xdest Ydest Zdest DataVal1 DataVal2 DataVal3 DataVal4… DataVal10
```

Note: It is also possible to take advantage of the area selection capabilities by defining polygonal regions at the start of the file. The format for these polygonal regions is

described in the Polygonal Region Data Format. The polygonal regions must have a header of `POLYS` alone on one line to start the data.

Format:

```
<TIME> <Xsrc> <Ysrc> <Zsrc> <Xcurr> <Ycurr> <Zcurr> <Xdest> <Ydest> <Zdest> <Data Value 1> [<Data Value 2> … <Data Value 10>]
```

Example:

```
TIME  Xsrc  Ysrc  Zsrc  Xcurr  Ycurr  Zcurr  Xdest  Ydest  Zdest  DataVal1
800   2000  4000  0     1000   15000  25000  1000   15000  25000  -1
800   3000  3215  0     1200   23000  20000  15000  25000  19874   8.4
```

3.1.6 Polygonal Region Data Evolution Format

There are two distinct sections in the Polygonal Region Data Evolution file format:

- the first section describes the polygonal regions, and
- the other section provides the timestep-dependent data.

The first section must start with the keyword `POLYS`, a keyword used to prevent loading of incompatible format data; this must be the first line.

Usage:

```
POLYS
```

The second line lists the number of polygons in the file, a space, and then the number of vertices in the file. The numbers can be larger than the actual number of vertices and polygons in the file but they cannot be smaller. Using the exact numbers for vertices and polygons uses memory most efficiently.

Usage:

```
Npolygons Nvertices
```

The third line is a polygonal region header. It is composed of an object text identifier (it is OK to use numbers here), followed by the number of vertices in the polygon, the extrusion height of the polygon (used to create the sides of the buildings), the red color value, the green color value, and the blue color value. If the polygon is flat, the extrusion height will be 0.0. The red, green, and blue values range from 0 to 255.

Usage:

```
ObjectID NverticesInPoly ExtrusionHeight RedValue GreenValue BlueValue
```

The next lines are the x, y, and z values of each vertice. There will be *NverticesInPoly* lines, followed by the next polygonal region header. This pattern is continued until all polygonal regions are defined.

Usage:

```
X(0) Y(0) Z(0)
X(1) Y(1) Z(1)
….
X(NverticesInPoly) Y(NverticesInPoly) Z(NverticesInPoly)
```

Example:

```
POLYS
203 32574
31 5 31.00 154 154 154
524024.1562 5042013.0000 0.0800
524025.8438 5041954.5000 0.0800
524050.9375 5041955.5000 0.0800
524049.2500 5042013.5000 0.0800
524024.1562 5042013.0000 0.0800
30 6 30.00 169 169 169
523863.1250 5041980.0000 0.0800
....
```

The data section follows the polygonal region definitions, and the fields are tab-delimited. Each line of the variable size box format contains at least five mandatory fields:

1) Time
2) Polygon Source Region
3) Polygon Current Region
4) Polygon Destination Region
5) Data Value

It is also possible to add up to nine more data-value columns. We suggest that you provide a labeling line on the first line of the file. This line should describe each column (as shown below).

Usage:

```
TIME Rsource Rcurrent Rdestination DataVal1 DataVal2 DataVal3 DataVal4… DataVal10
```

Format:

```
<TIME> <Xsrc> <Ysrc> <Zsrc> <Xcurr> <Ycurr> <Zcurr> <Xdest> <Ydest> <Zdest> <Data Value 1> [<Data Value 2> … <Data Value 10>]
```

Example:

```
TIME  Rsource Rcurrent Rdestination DataVal1
800   2000    4000     0            1000
800   3000    3215     0            1200
```

3.1.7 Underlay Format

The Underlay file format describes polygons that are to be drawn in every region. It can be used to add rivers, lakes, buildings, parks, etc., to the display. The file format is the same as the first section of the Polygonal Region Data Evolution format. It is repeated below for convenience.

The first section must start with the keyword `POLYS`, a keyword used to prevent loading of incompatible format data. This must be the first line.

Usage:

```
POLYS
```

The second line lists the number of polygons in the file, a space, and then the number of vertices in the file. The numbers can be larger than the actual number of vertices and polygons in the file but they cannot be smaller. Using the exact numbers for vertices and polygons uses memory most efficiently.

Usage:

```
Npolygons Nvertices
```

The third line is a polygonal region header. It is composed of an object text identifier (it is OK to use numbers here), followed by the number of vertices in the polygon, the extrusion height of the polygon (used to create the sides of the buildings), the red color value, the green color value, and the blue color value. If the polygon is flat, the extrusion height will be 0.0. The red, green, and blue values range from 0 to 255.

Usage:

```
ObjectID NverticesInPoly ExtrusionHeight RedValue GreenValue BlueValue
```

The next lines are the x, y, and z values of each vertice. There will be *NverticesInPoly* lines, followed by the next polygonal region header. This pattern is continued until all polygonal regions are defined.

Usage:

```
X(0) Y(0) Z(0)
X(1) Y(1) Z(1)
….
X(NverticesInPoly) Y(NverticesInPoly) Z(NverticesInPoly)
```

Example:

```
POLYS
203 32574
31 5 31.00 154 154 154
524024.1562 5042013.0000 0.0800
524025.8438 5041954.5000 0.0800
```

```
524050.9375 5041955.5000 0.0800
524049.2500 5042013.5000 0.0800
524024.1562 5042013.0000 0.0800
30 6 30.00 169 169 169
523863.1250 5041980.0000 0.0800
....
```

3.1.8 Visualizer Configuration Key File Format

The Visualizer Configuration Key file format is simply each configuration file key followed by its value on a single line. Comments can be included in the file by placing a '#' in the first character of the comment line. Comments will be ignored. It is not necessary to have every configuration file key defined in each file. You may delete the unnecessary keys. Neither is it necessary to list the configuration file keys in any particular order. Each configuration file key is described fully in Appendix C. Note that only a subset of these keys are read and set from the configuration file used when starting the Output Visualizer. Appendix B provides a listing of the configuration file keys read and set from the configuration file that is used to run the Output Visualizer. The purpose of a more extensive set is to enable the entire set of configurable variables to be saved and reset without having to restart the Output Visualizer, and to enable many features of the batch command file processing capabilities.

Example:

```
# Configuration File Key Example
VIS_VEHICLE_POINTSIZE                       0.000
VIS_VEHICLE_DRAWMODE                        0
VIS_VEHICLE_DRAW3D                          0
VIS_BACKGROUND_RED                          0.45
VIS_BACKGROUND_GREEN                        0.64
VIS_BACKGROUND_BLUE                         1.00
VIS_BACKGROUND_ALPHA                        0.00
VIS_NETWORK_VIEW_LINKS                      1
VIS_NETWORK_VIEW_ACTIVITY_LOCATIONS         0
VIS_NETWORK_VIEW_BOXES                      0
VIS_NETWORK_VIEW_NODES                      0
VIS_NETWORK_VIEW_TRANSIT                    0
VIS_NETWORK_VIEW_PARKING                    0
VIS_NETWORK_VIEW_BARRIERS                   0
VIS_NETWORK_VIEW_DETECTORS                  0
VIS_BOXES_COLOR_RED                         0.25
VIS_BOXES_COLOR_GREEN                       0.25
VIS_BOXES_COLOR_BLUE                        0.25
VIS_LABELS_COLOR_RED                        0.05
VIS_LABELS_COLOR_GREEN                      0.04
VIS_LABELS_COLOR_BLUE                       0.00
VIS_ACTIVITIES_COLOR_RED                    0.00
VIS_ACTIVITIES_COLOR_GREEN                  0.50
VIS_ACTIVITIES_COLOR_BLUE                   0.50
VIS_BARRIERS_COLOR_RED                      1.00
VIS_BARRIERS_COLOR_GREEN                    0.00
VIS_BARRIERS_COLOR_BLUE                     1.00
VIS_DETECTORS_COLOR_RED                     0.00
```

```
VIS_DETECTORS_COLOR_GREEN                    0.00
VIS_DETECTORS_COLOR_BLUE                     0.00
VIS_NODES_COLOR_RED                          1.00
VIS_NODES_COLOR_GREEN                        0.00
VIS_NODES_COLOR_BLUE                         0.00
VIS_TRANSITS_COLOR_RED                       0.00
VIS_TRANSITS_COLOR_GREEN                     1.00
VIS_TRANSITS_COLOR_BLUE                      0.00
VIS_PARKINGS_COLOR_RED                       0.00
VIS_PARKINGS_COLOR_GREEN                     0.50
VIS_PARKINGS_COLOR_BLUE                      0.00
VIS_LINKS_COLOR_RED                          0.60
VIS_LINKS_COLOR_GREEN                        0.60
VIS_LINKS_COLOR_BLUE                         0.60
VIS_NETWORK_ACTIVITY_LOCATION_POINTSIZE      0.00
VIS_NETWORK_BARRIER_POINTSIZE                0.00
VIS_NETWORK_DETECTOR_POINTSIZE               0.00
VIS_NETWORK_NODE_POINTSIZE                   0.00
VIS_NETWORK_PARKING_POINTSIZE                0.00
VIS_NETWORK_TRANSIT_POINTSIZE                0.00
VIS_SLIDER_XROT                              298.08
VIS_SLIDER_YROT                              0.00
VIS_SLIDER_ZROT                              41.76
VIS_SLIDER_THRESHOLD                         1.000
VIS_SLIDER_SCALE                             3.06
VIS_SLIDER_SPEED                             1.00
VIS_INITIAL_TRANSLATE_X                      -18375.71875
VIS_INITIAL_TRANSLATE_Y                      -17610.86328
VIS_INITIAL_TRANSLATE_Z                      0.00000
NET_LANE_WIDTH                               3.50
VIS_SUMMARY_TRANSMODE                        0
VIS_SUMMARY_COLORMODE                        1
VIS_SUMMARY_COLORMAP_MIN                     0.00000
VIS_SUMMARY_COLORMAP_MAX                     60.00000
VIS_SUMMARY_TWOMAPMODE                       0
VIS_SUMMARY_TWOMAP1MAP_MIN                   0.00000
VIS_SUMMARY_TWOMAP1MAP_MAX                   60.00000
VIS_SUMMARY_TWOMAP2MAP_MIN                   0.00000
VIS_SUMMARY_TWOMAP2MAP_MAX                   40000.00000
VIS_SUMMARY_TWOMAP1_COLORMODE                0
VIS_SUMMARY_TWOMAP2_COLORMODE                0
VIS_SUMMARY_COLORMAP_COLUMN                  0
VIS_SUMMARY_TWOMAP1_COLUMN                   0
VIS_SUMMARY_TWOMAP2_COLUMN                   1
VIS_SUMMARY_BARMMODE                         1
VIS_SUMMARY_BAR_COLUMN                       0
VIS_SUMMARY_BAR_THREEDSF                     1.00000
VIS_NETFEATURE_TRANSMODE                     0
VIS_NETFEATURE_COLORMODE                     1
VIS_NETFEATURE_COLORMAP_MIN                  0.00000
VIS_NETFEATURE_COLORMAP_MAX                  60.00000
VIS_NETFEATURE_TWOMAPMODE                    0
VIS_NETFEATURE_TWOMAP1MAP_MIN                0.00000
VIS_NETFEATURE_TWOMAP1MAP_MAX                60.00000
VIS_NETFEATURE_TWOMAP2MAP_MIN                0.00000
VIS_NETFEATURE_TWOMAP2MAP_MAX                40000.00000
VIS_NETFEATURE_TWOMAP1_COLORMODE             0
```

```
VIS_NETFEATURE_TWOMAP2_COLORMODE            0
VIS_NETFEATURE_COLORMAP_COLUMN              0
VIS_NETFEATURE_TWOMAP1_COLUMN               0
VIS_NETFEATURE_TWOMAP2_COLUMN               1
VIS_NETFEATURE_BARMMODE                     1
VIS_NETFEATURE_BAR_COLUMN                   0
VIS_NETFEATURE_BAR_THREEDSF                 1.00000
VIS_LEGENDMODE                              0
VIS_LIGHTSMODE                              1
VIS_LABELMODE                               0
VIS_RIDEINVEHICLEMODE                       0
VIS_OVERLAYMODE                             1
VIS_THREEDNETMODE                           1
VIS_THREEDBARMODE                           0
VIS_FVTRANSLATEMODE                         0
VIS_SET_VEHICLE_ID                          586845
VIS_BOXESDRAWMODE                           2
```

3.1.9 Visualizer Batch Command File Format

The Visualizer Batch Command File format provides a way for the Output Visualizer to execute commands from a file. In fact, by setting a configuration file key, the Output Visualizer can even be run remotely to produce images for their incorporation into reports/presentations/movies. The Output Visualizer can be started in batch mode by including the following line in the configuration file used to run the Output Visualizer:

```
VIS_EXECUTE_BATCHFILE File
```

where

`File` is the full path and filename of the Output Visualizer batch command file to process.

Each batch command is described below followed by a few examples.

Batch Command	Description
#	A comment starts with a # as the first character of the line. Usage: `# ignored characters…`
`OPEN_INDEXED_VEHICLES`	Opens an Indexed Vehicle file. Usage: `OPEN_INDEXED_VEHICLES File` where `File` is the full path and filename of the file to open.
`OPEN_LINK_SPACE_SUMMARY`	Opens a Link Space Summary file. Usage: `OPEN_LINK_SPACE_SUMMARY File` where `File` is the full path and filename of the file to open.

Batch Command	Description
OPEN_LINK_DATA	Opens a Link Data file. Usage: OPEN_LINK_DATA File where File is the full path and filename of the file to open.
OPEN_NETFEATURE_DATA	Opens a Network Features file. Usage: OPEN_NETFEATURE_DATA File where File is the full path and filename of the file to open.
OPEN_VARIABLE_SIZE_BOX_DATA	Opens a Variable Size Box data file. Usage: OPEN_VARIABLE_SIZE_BOX_DATA File where File is the full path and filename of the file to open.
OPEN_SIGNAL_DATA	Opens a Traffic Controls file. Usage: OPEN_SIGNAL_DATA File where File is the full path and filename of the file to open.
OPEN_INTERSECTION_QUEUE_DATA	Opens an Intersection Queue file. Usage: OPEN_INTERSECTION_QUEUE_DATA File where File is the full path and filename of the file to open.
OPEN_LINK_SPACE_SUMMARY_DATA	Opens a Link Space Summary Box file. Usage: OPEN_LINK_SPACE_SUMMARY_DATA File where File is the full path and filename of the file to open.
OPEN_POINT_DATA	Opens a Point Data file. Usage: OPEN_POINT_DATA File where File is the full path and filename of the file to open.
OPEN_REGIONAL_DATA	Opens a Polygonal Region Data file. Usage: OPEN_REGIONAL_DATA File where File is the full path and filename of the file to open.
OPEN_UNDERLAY_DATA	Opens an Underlay file. Usage: OPEN_UNDERLAY_DATA File where File is the full path and filename of the file to open.
SET_VEHICLE_ID	Set the Vehicle ID to Ride In for the Ride In Vehicle mode. Usage: SET_VEHICLE_ID VehicleID where VehicleID is the vehicle ID that the Ride In vehicle mode sets the viewpoint.
OPEN_ONE_COLORMAP	Opens a single binary colormap file. Usage: OPEN_ONE_COLORMAP File DataColumn where File is the full path and filename to open, and DataColumn is the number of the data column for which to read the colormap.

Batch Command	Description
OPEN_COLORMAP_SET	Opens a complete binary colormap file with all of the colormaps. Usage: OPEN_COLORMAP_SET File where File is the full path and filename of the file to open.
READ_VIS_CONFIGKEYS	Opens a Visualizer Configuration Key file and sets the configuration specified by the file. Usage: READ_VIS_CONFIGKEYS File where File is the full path and filename of the file to open.
GOTIME	Sets the timestep to display. Usage: GOTIME Timestep where Timestep is the timestep to display. Timestep can be either in the seconds from midnight format or in the HH:MM:SS format. If you wish to record a timestep that is more than 24 hours from midnight, do not use the HH:MM:SS format because the time will not be found. An error is printed if the timestep requested cannot be found in the data, but batch file command processing is continued.
RECORDFRAME	Saves the currently displayed viewing area to a TIFF image file. Usage: RECORDFRAME File where File is the full path and filename to store the TIFF image file. A filename extension is not appended to the filename; consequently, you should add the .tiff or .tif file extension to File.
CHANGEDIR	Changes the current working directory. Usage: CHANGEDIR Dir where Dir is the full path name of a directory that will become the current working directory. This command is provided as a convenience for those who would rather not use full path names in other batch commands.
SET_VIEW_WINDOW_SIZE	Sets the size of the viewing window. Usage: SET_VIEW_WINDOW_SIZE Width Height where Width is the width in pixels, and Height is the height in pixels of the desired view window size. The view window size must be small enough to view on the monitor of the computer on which the Output Visualizer is currently running.
EXIT	Terminates the Output Visualizer. Usage: EXIT

Batch Command	Description
`RECORDMODE XREVROT YREVROT ZREVROT`	Sets the Output Visualizer into recording mode, and records a sequence of images. Usage: `RECORDMODE StartVizConfig StartTimestep EndVizConfig EndTimestep FileSeqName Xrot Yrot Zrot Images` where: `StartVizConfig` is the Output Visualizer configuration key file to get the initial orientation from, `StartTimestep` is the timestep for the initial image to be produced, `EndVizConfig` is the Output Visualizer configuration file to get the last orientation from, `EndTimestep` is the timestep for the last image to be produced, `FileSeqName` is the root file name to which a sequence of numbers will be added to produce the image file names, `Xrot` is the x rotation direction, which can be either `XROT` or `XREVROT`, `Yrot` is the y rotation direction, which can be either `YROT` or `YREVROT`, `Zrot` is the z rotation direction, which can be either `ZROT` or `ZREVROT`, and `Images` is the number of images to produce. The `REV` in the `XREVROT, YREVROT`, and `ZREVROT` reverses the default rotation direction. The default rotation direction (positive or negative degree increments) is defined by the final rotation angle minus the initial rotation angle.
`FULLSCREEN1280X1024`	Sets the main (or full) Output Visualizer window to be 1280 pixels by 1024 pixels. Usage: `FULLSCREEN1280X1024`
`SET_MAIN_WINDOW_SIZE`	Sets the main (or full) Output Visualizer window to be a particular size. Usage: `SET_MAIN_WINDOW_SIZE Width Height` where `Width` is the width in pixels, and `Height` is the height in pixels of the desired main window size of the Output Visualizer. Note: There is no error recovery code that prevents the user from attempting to set the view and main window sizes to incompatible parameters (e.g., A view window size larger than the main window size).
`CLOSE_NETFEATURE_DATA`	Closes the currently opened Network Features file. Usage: `CLOSE_NETFEATURE_DATA`
`CLOSE_LINK_DATA`	Closes the currently opened Link Data file. Usage: `CLOSE_LINK_DATA`

Batch Command	Description
CLOSE_SUMDATA	Closes the currently opened Link Space Summary Boxes data file. Usage: CLOSE_SUMDATA
CLOSE_VEHICLE_DATA	Closes the currently opened Indexed Vehicle data file. Usage: CLOSE_VEHICLE_DATA
CLOSE_POINT_DATA	Closes the currently opened Point data file. Usage: CLOSE_POINT_DATA
CLOSE_REGION_DATA	Closes the currently opened Polygonal Region data file. Usage: CLOSE_REGION_DATA
CLOSE_UNDERLAY_DATA	Closes the currently opened Underlay file. Usage: CLOSE_UNDERLAY_DATA
CLOSE_VARIABLE_SIZE_BOX_DATA	Closes the currently opened Variable Size Box data file. Usage: CLOSE_VARIABLE_SIZE_BOX_DATA
CLOSE_SIGNAL_DATA	Closes the currently opened Traffic Controls data file. Usage: CLOSE_SIGNAL_DATA
CLOSE_INTERSECTION_QUEUE_DATA	Closes the currently opened Intersection Queue data file. Usage: CLOSE_INTERSECTION_QUEUE_DATA

Example:

The following batch command file produces a set of images from summary data in two different configurations, then produces more images of vehicle data in two different configurations. This is useful for comparing data from different runs.

```
#
# Processing Summaries iteration 24
#
FULLSCREEN1280X1024
#
#
# open a link space summary file
OPEN_LINK_SPACE_SUMMARY    /MS24/summary.dens.spa
# read a visualizer configuration file
READ_VIS_CONFIGKEYS        /VisConfigs/AllstrSummaryWlegend.viscfg
# set to time 6 am
GOTIME                     6:00:00
# save the image to a TIFF file
RECORDFRAME                /Images/MS24.allstr.summary.0600.tif
GOTIME                     7:00:00
RECORDFRAME                /Images/MS24.allstr.summary.0700.tif
GOTIME                     11:00:00
RECORDFRAME                /Images/MS24.allstr.summary.1100.tif
READ_VIS_CONFIGKEYS        /VisConfigs/CentralSummaryWlegend.viscfg
GOTIME                     7:00:00
RECORDFRAME                /Images/MS24.center.summaryL.0700.tif
READ_VIS_CONFIGKEYS        /VisConfigs/CentralSummary.viscfg
GOTIME                     6:00:00
RECORDFRAME                /Images/MS24.center.summary.0600.tif
GOTIME                     7:00:00
RECORDFRAME                /Images/MS24.center.summary.0700.tif
```

```
   GOTIME                     11:00:00
   RECORDFRAME                /Images/MS24.center.summary.1100.tif
   # close the link space summary file
   CLOSE_SUMDATA
   #
   # Processing Snapshots
   # open an indexed vehicle file
   OPEN_INDEXED_VEHICLES      /MS24/VehMS24snapAM.ibin
   READ_VIS_CONFIGKEYS        /VisConfigs/AllstrSnapshotDB.viscfg
   GOTIME                     6:00:00
   RECORDFRAME                /Images/MS24.allstr.snapshot.0600.tif
   GOTIME                     7:00:00
   RECORDFRAME                /Images/MS24.allstr.snapshot.0700.tif
   GOTIME                     11:00:00
   RECORDFRAME                /Images/MS24.allstr.snapshot.1100.tif
   READ_VIS_CONFIGKEYS        /VisConfigs/CentralSnapshotDB.viscfg
   GOTIME                     6:00:00
   RECORDFRAME                /Images/MS24.center.snapshot.0600.tif
   GOTIME                     7:00:00
   RECORDFRAME                /Images/MS24.center.snapshot.0700.tif
   GOTIME                     11:00:00
   RECORDFRAME                /Images/MS24.center.snapshot.1100.tif
   CLOSE_VEHICLE_DATA
   #
   # Done
   #
   EXIT
#
```

Example:

The following script produces over 400 images by changing the Output Visualizer configurations and using the `RECORDMODE` batch command to create configurations in between those given by the configuration files. This is useful for producing the content for movies.

```
   #
   #  This is a script to record images for a movie files
   #
   SET_VIEW_WINDOW_SIZE       640 480
   #
   #
   OPEN_NETFEATURE_DATA       NetFeatureData.vis
   #
   #
   #  read a colormap in for data column 3
   OPEN_ONE_COLORMAP          SampleMap.bin 3
   #
   OPEN_UNDERLAY_DATA         ARivsLatest.polys
   #
   READ_VIS_CONFIGKEYS        Default.viscfg
   # record an animated sequence in the default configuration
   RECORDMODE Def.viscfg 259200  Def.viscfg 5097600 DefVSeq XROT YROT ZROT 57
   # zoom in and rotate to a wide area view
   RECORDMODE  Def.viscfg 259200 Zout.viscfg 259200 DefToZout XREVROT YROT ZROT 55
   # record an animated sequence
```

```
RECORDMODE Zout.viscfg 259200 Zout.viscfg 5097600 ZoutSeq XROT YROT ZROT 57
# zoom in to medium area view
RECORDMODE Zout.viscfg 259200 Zmed.viscfg 259200 ZoutToMed XROT YROT ZROT 45
# record an animated sequence
RECORDMODE Zmed.viscfg 259200 Zmed.viscfg 5097600 ZmedSeq XROT YROT ZROT 57
# record a few timesteps of an animated sequence
RECORDMODE Zmed.viscfg 259200 Zmed.viscfg 1728000 ZmedTo20Seq XROT YROT ZROT
19
# record a sequence of frames at the same timestep while rotating the view
RECORDMODE Zmed.viscfg 1728000 ZmedTo3.viscfg 1728000 ZmedRot XROT YROT ZROT 153
#
CLOSE_NETFEATURE_DATA
#
# exit the visualizer
EXIT
```

3.2 Output Visualizer Library Files

Appendix A lists the Output Visualizer library files.

3.3 Configuration File Keys

Appendix B lists the Mandatory Output Visualizer configuration file keys.

Appendix C lists the Optional Output Visualizer configuration file keys that may be used in the configuration file.

Appendix D lists the configuration file keys that are changeable interactively through the use of Visualizer Configuration Keys files.

4. UTILITY PROGRAMS

4.1 *indexvehtobin* Utility

The *indexvehtobin* utility creates indexed vehicle file formats from the text vehicle snapshot files. This utility is used to maximize the capabilities of the Output Visualizer when viewing vehicles. It also does not care about the ordering of the columns in the vehicle snapshot input file.

The *indexvehtobin* utility converts IOC-2 text format to the indexed binary vehicle format required by the Output Visualizer. Usage is as follows:

```
indexvehtobin inputfilename outputfilename
```

4.2 *mkmap* Utility

The *mkmap* utility produces any number of colormaps from a text-input file for compilation into the Output Visualizer. All colormaps have 256 colors.

Usage of *mkmap* is as follows:

```
mkmap inputfile outputfile
```

where `inputfile` consists of a file of the format described above, and the output file is an ASCII text file that can be pasted into the *colormaps.h* file for compiling into the Output Visualizer.

Appendix E provides the default colormap input file format. In this format, the first line is the number of colormaps followed by the total number of lines in the file (minus the first line). Each colormap is followed by the number of colors in the colormap, as well as by the minimum and maximum value (followed by a text string that is ignored). A color number as given in the *mkmap* source file follows each colormap threshold value.

The colormaps in Appendix E are default maps compiled into the application. The first two colormaps are used for summary box data. The third colormap is used for the first variable size box data column; the fourth colormap is used for the second variable size box data column; and so on. The last four colormaps are used to color vehicles by type, passengers, velocity and user field. In all, there are 16 colormaps in the Output Visualizer.

4.3 *mkallbinmaps* Utility

The *mkallbinmaps* utility produces any number of binary colormaps from a text-input file. All colormaps have 256 colors

Usage of *mkallbinmaps* is as follows:

```
Mkallbinmaps inputfile outputfile
```

where `inputfile` consists of a file of the format described above, and the output file is a binary colormaps file that can be read into the Output Visualizer to change all of the colormaps interactively through the Edit→Change All Colormaps menu option.

Appendix E contains the default colormap input file format.

4.4 *mk1binmap* Utility

The *mk1binmap* utility produces a single binary colormap file for use in describing a single colormap that can be read into the Output Visualizer.

Usage of *mk1binmap* is as follows:

```
Mk1binmap inputfile outputfile
```

where `inputfile` consists of a description of a single colormap file of the format described above, and the output file is a binary colormap file that can be read into the Output Visualizer.

Changing a single colormap in the Output Visualizer is done by clicking [Change XXX Colormap] in a dialog box and selecting the file produced by the *mk1binmap* utility from the File Selector dialog box that is displayed.

Appendix F contains an example single colormap text input file.

4.5 Color Index

The index of colors used in *mkmap* and other colormap utilities is as follows:

0 =	Dark Green	7 =	Blue
1 =	Light Green	8 =	White
2 =	Teal	9 =	Yellow
3 =	Light Red	10 =	Purple
4 =	Dark Red	11 =	Background Blue
5 =	Orange	12 =	Light Grey
6 =	Black	13 =	Grey

Appendix A: Output Visualizer Library Files

Type	File Name	Description
Binary Files	*libTIO.a*	The TRANSIMS Interfaces library.
Indexehtobin Source Files	*Indexvehtobin.c*	Converts IOC-2 text data files into indexed binary vehicle snapshot files for use with the Output Visualizer.
Mkmap Source Files	*Mkmap.c*	Converts a text input colormap description file with 16 colormaps into a text output file suitable for pasting into the *colormaps.h* file and compiling into the Output Visualizer.
Mk1binmap Source Files	*Mk1binmap.c*	Converts a text input colormap description file with only one colormap into a binary colormap input file readable by the Output Visualizer.
Mkallbinmaps Source Files	*Mkallbinmaps.c*	Converts a text input colormap description file with 16 colormaps into a binary colormap file suitable for changing all the colormaps used by the Output Visualizer at once.

Appendix B: Mandatory Output Visualizer Configuration File Keys

Configuration File Key	Description
CA_CELL_LENGTH	The length of a cell in meters. Default = 7.5
NET_ACTIVITY_LOCATION_TABLE	The name of the network activity location table or an empty activity location table.
NET_BARRIER_TABLE	The name of a network barrier table or an empty barrier table.
NET_DIRECTORY	The name of the directory containing the network tables.
NET_LANE_WIDTH	The width of a lane in meters. Default = 3.5 Note: The settings for NET_LANE_WIDTH used by the Output Visualizer must be the same as those used by the output system for the vehicles to be placed properly on the network.
NET_LINK_MEDIAN_HALFWIDTH	The distance that the links are offset from the node; must be set to ½ of NET_LANE_WIDTH. Note: this key must be the same for collecting output and running the Output Visualizer; otherwise, vehicles will not be centered properly in lanes.
NET_LINK_TABLE	The name of the network link table.
NET_NODE_TABLE	The name of the network node table.
NET_PARKING_TABLE	The name of the network parking table or an empty parking table.
NET_POCKET_LANE_TABLE	The name of the network pocket lane table or an empty pocket lane table.
NET_TRANSIT_STOP_TABLE	The name of network transit stop table or an empty transit stop table .
OUT_SNAPSHOT_SUPPRESS_1	These keys determine what fields to suppress in the snapshot output file. Nothing needs to be suppressed, but the text vehicle evolution file size will be reduced if the key is set to: ACCELER;DRIVER;USER;LANE;NODE;DISTANCE.
VIS_BOX_LENGTH	The summary box length in meters; should be 150 (meters).

Appendix C: Optional Output Visualizer Configuration File Keys That May Be Used in the Configuration File

These configuration file keys are read from the configuration file that is used in running the Output Visualizer. They are fewer in number than those that can be read/set after the Output Visualizer is running (see Appendix D).

Configuration File Key	Description
VIS_BACKGROUND_ALPHA	The alpha color value for the viewing area background, 0.0 to 1.0. Not used at this time.
VIS_BACKGROUND_BLUE	The blue color value for the viewing area background, 0.0 to 1.0.
VIS_BACKGROUND_GREEN	The green color value for the viewing area background, 0.0 to 1.0.
VIS_BACKGROUND_RED	The red color value for the viewing area background, 0.0 to 1.0.
VIS_COLORMAPS	The full path and file name of a set of colormaps produced with the *mkallbinmaps* utility to use in the Output Visualizer.
VIS_NETWORK_ACTIVITY_LOCATION_POINTSIZE	The size of an activity location point, 0.0 to 10.0.
VIS_NETWORK_BARRIER_POINTSIZE	The size of a barrier point, 0.0 to 10.0..
VIS_NETWORK_DETECTOR_POINTSIZE	The size of a detector point, 0.0 to 10.0
VIS_NETWORK_NODE_POINTSIZE	The size of a node point, 0.0 to 10.0.
VIS_NETWORK_PARKING_POINTSIZE	The size of a parking accessory point, 0.5 to 10.0.
VIS_NETWORK_TRANSIT_POINTSIZE	The size of a transit stop point, 0.0 to 10.0.
VIS_NETWORK_VIEW_ACTIVITY_LOCATIONS	The toggle to view activity locations. 0 – Do not view activity locations 1 – View activity locations
VIS_NETWORK_VIEW_BARRIERS	The toggle to view barriers. 0 – Do not view barriers 1 – View barriers
VIS_NETWORK_VIEW_BOXES	The toggle to view boxes. 0 – Do not view boxes 1 – View boxes
VIS_NETWORK_VIEW_DETECTORS	The toggle to view detectors. 0 –Do not view detectors 1 – View detectors

Configuration File Key	Description
VIS_NETWORK_VIEW_LANE_DIVIDERS	The toggle to view lane dividers. 0 – Do not view lane dividers 1 – View lane dividers
VIS_NETWORK_VIEW_LINKS	The toggle to view links. 0 – Do not view links 1 – View links
VIS_NETWORK_VIEW_NODES	The toggle to view nodes. 0 – Do not view nodes 1 – View nodes
VIS_NETWORK_VIEW_PARKING	The toggle to view parking. 0 – Do not view parking 1 – View parking
VIS_NETWORK_VIEW_TRANSIT	The toggle to view transit stops. 0 – Do not view transit stops 1 – View transit stops
VIS_SINGLE_BUFFERED	The toggle for double or single buffered. 0 – Double buffered (default) 1 – Single buffered The value should always be 0 unless the video adapter will not allow double buffering.
VIS_SLIDER_SCALE	The initial scale, 1.0 and larger. Default = 1.0
VIS_SLIDER_SPEED	The initial speed, 0.005 to 1.0. Default = 1.0
VIS_SLIDER_THRESHOLD	The initial threshold, 0.005 to 1.0 Default = 1.0
VIS_SLIDER_XROT	The initial X rotation, 0.0 to 360.0. Default = 0.0
VIS_SLIDER_YROT	The initial Y rotation, 0.0 to 360.0. Default = 0.0
VIS_SLIDER_ZROT	The initial Z rotation, 0.0 to 360.0. Default = 0.0
VIS_UNDERLAYFILE	The name of a file to be read in and drawn underneath the network. This file must be of the Underlay file format. This can be used to add objects to the network that are visible at all times.
VIS_VEHICLE_DRAW3D	The toggle for 2D or 3D vehicles. 0 – 2D vehicles 1 – 3D vehicles

Configuration File Key	Description
VIS_VEHICLE_DRAWMODE	The coloring method for vehicles, 0 to 0 – Same color mode 1 – Color by Type mode 2 – Color by Passengers mode 3 – Color by Velocity mode 4 – Random coloring by vehicle ID 5 – Color by User field mode
VIS_VEHICLE_POINTSIZE	The size of a vehicle when it is a point, 0.0 to 10.0.
VIS_XSLIDER_360DEFAULT	The toggle for default X rotation. 0 – Default X rotation of 0.0 1 – Default X rotation of 360.0
VIZ_EXECUTE_BATCHFILE	The full path name and filename of the Output Visualizer Batch Command file to execute upon startup of the Output Visualizer.

Appendix D: Output Visualizer Configuration File Keys That May Be Read Interactively

Configuration File Key	Description
#Latest Keys start here...	An optional comment line that may be included in the file for bookkeeping purposes.
NET_LANE_WIDTH	The network lane width. Default = 3.5
VIS_ACTIVITIES_COLOR_BLUE	The blue color value for drawing activity locations, 0.0 to 1.0.
VIS_ACTIVITIES_COLOR_GREEN	The green color value for drawing activity locations, 0.0 to 1.0.
VIS_ACTIVITIES_COLOR_RED	The red color value for drawing activity locations, 0.0 to 1.0.
VIS_BACKGROUND_ALPHA	The alpha color value for the viewing area background, 0.0 to 1.0. Not used at this time.
VIS_BACKGROUND_BLUE	The blue color value for the viewing area background, 0.0 to 1.0.
VIS_BACKGROUND_GREEN	The green color value for the viewing area background, 0.0 to 1.0.
VIS_BACKGROUND_RED	The red color value for the viewing area background, 0.0 to 1.0.
VIS_BARRIERS_COLOR_BLUE	The blue color value for drawing barriers, 0.0 to 1.0.
VIS_BARRIERS_COLOR_GREEN	The green color value for drawing barriers, 0.0 to 1.0.
VIS_BARRIERS_COLOR_RED	The red color value for drawing barriers, 0.0 to 1.0.
VIS_BOXES_COLOR_BLUE	The blue color value for drawing boxes, 0.0 to 1.0.
VIS_BOXES_COLOR_GREEN	The green color value for drawing boxes, 0.0 to 1.0.
VIS_BOXES_COLOR_RED	The red color value for drawing boxes, 0.0 to 1.0.
VIS_BOXESDRAWMODE	The toggle to select how boxes are drawn. 0 – Boxes are drawn as solid polygons 1 – Boxes are drawn with lines tracing the box edges 2 – Boxes are drawn as solid polygons and the edges outlined (default)
VIS_DETECTORS_COLOR_BLUE	The blue color value for drawing detectors, 0.0 to 1.0.
VIS_DETECTORS_COLOR_GREEN	The green color value for drawing detectors, 0.0 to 1.0.

Configuration File Key	Description
VIS_DETECTORS_COLOR_RED	The red color value for drawing detectors, 0.0 to 1.0.
VIS_FVTRANSLATEMODE	The toggle to determine whether the Follow Vehicle mode is `on` or `off`, 0 – Follow Vehicle mode is `off` (default) 1 – Follow Vehicle mode is `on`
VIS_INITIAL_TRANSLATE_X	The X translation in utm coordinates.
VIS_INITIAL_TRANSLATE_Y	The Y translation in utm coordinates.
VIS_INITIAL_TRANSLATE_Z	The Z translation in utm coordinates.
VIS_LABELMODE	The toggle to determine whether labels are shown. 0 – Do not show labels (default) 1 – Show labels
VIS_LABELS_COLOR_BLUE	The blue color value for drawing labels, 0.0 to 1.0.
VIS_LABELS_COLOR_GREEN	The green color value for drawing labels, 0.0 to 1.0.
VIS_LABELS_COLOR_RED	The red color value for drawing labels, 0.0 to 1.0.
VIS_LEGENDMODE	The toggle to determine whether a legend is shown. 0 – Do not show a legend (default) 1 – Show a legend
VIS_LIGHTSMODE	The toggle to determine whether the lighting model is `on` or `off`, 0 – Lighting model is `off` (default) 1 – Lighting model is `on`
VIS_LINKS_COLOR_BLUE	The blue color value for drawing links, 0.0 to 1.0.
VIS_LINKS_COLOR_GREEN	The green color value for drawing links, 0.0 to 1.0.
VIS_LINKS_COLOR_RED	The red color value for drawing links, 0.0 to 1.0.
VIS_NETFEATURE_BAR_COLUMN	Indicates which data column is used to calculate the height of the 3D Bars. It can be 0 to 9 and must be an integer (default 0). This setting applies to viewing network features, point, and regional polygon data.
VIS_NETFEATURE_BAR_THREEDSF	Indicates the amount to multiply the data value from the specified data column to determine the height of the 3D Bars to draw. It can be any number, but negative numbers should be avoided if the data column is non-negative (negative heights will be difficult to interpret). This setting applies to viewing network features, point, and regional polygon data.

Configuration File Key	Description
VIS_NETFEATURE_BARMMODE	The toggle to create 3D bar graphs from the data when viewing network features, point, and regional polygon data. 1 – Use 3D bar graphs (default) 0 – Do not use 3D bar graphs
VIS_NETFEATURE_COLORMAP_COLUMN	Indicates which data column is used for single color mapping; it can be 0 to 9 and must be an integer (default 1). This setting applies to viewing network feature, point and regional polygon data.
VIS_NETFEATURE_COLORMAP_MAX	The maximum value to use for the colormap when a single colormap is used. It can be any number. This setting applies to viewing network features, point, and regional polygon data.
VIS_NETFEATURE_COLORMAP_MIN	The minimum value to use for the colormap when a single colormap is used. It can be any number. This setting applies to viewing network features, point, and regional polygon data.
VIS_NETFEATURE_COLORMODE	The toggle to use single color mapping of the data when viewing network features, point, and regional polygon data. 1 – Use single color mapping (default) 0 – Do not use single color mapping
VIS_NETFEATURE_TRANSMODE	The toggle to use transparency filtering of the data when viewing network features, point, and regional polygon data. 1 – Use transparency 0 – Do not use transparency
VIS_NETFEATURE_TWOMAP1_COLORMODE	The toggle to define which color scheme to use for the first colormap when two-color mapping is used. 0 – Black to Red is used (default) 1 – Black to Green is used 2 – Black to Blue is used This setting applies to viewing network feature, point, and regional polygon data.
VIS_NETFEATURE_TWOMAP1_COLUMN	Indicates which data column is used for two-color mapping for the first colormap; it can be 0 to 9 and must be an integer (default 1). This setting applies to viewing network feature, point and regional polygon data.
VIS_NETFEATURE_TWOMAP1MAP_MAX	The maximum value to use for the first colormap when a two-colormap is used. It can be any number. This setting applies to viewing network features, point, and regional polygon data.

Configuration File Key	Description
VIS_NETFEATURE_TWOMAP1MAP_MIN	The minimum value to use for the first colormap when a two-colormap is used. It can be any number. This setting applies to viewing network features, point, and regional polygon data.
VIS_NETFEATURE_TWOMAP2_COLORMODE	The toggle to define which color scheme to use for the second colormap when two-color mapping is used. 0 – Left to Right is used (default) 1 – Right to Left to Green is used This means that if the VIS_SUMMARY_TWOMAP1_COLORMODE is 0, a value of 0 would produce a Green to Blue colormap, whereas a value of 1 would produce a Blue to Green colormap. This setting applies to viewing network feature, point, and regional polygon data.
VIS_NETFEATURE_TWOMAP2_COLUMN	Indicates which data column is used for two-color mapping for the second colormap; it can be 0 to 9 and must be an integer (default 1). This setting applies to viewing network feature, point, and regional polygon data.
VIS_NETFEATURE_TWOMAP2MAP_MAX	The maximum value to use for the second colormap when a two-colormap is used. It can be any number. This setting applies to viewing network features, point, and regional polygon data.
VIS_NETFEATURE_TWOMAP2MAP_MIN	The minimum value to use for the second colormap when a two-colormap is used. It can be any number. This setting applies to viewing network features, point, and regional polygon data.
VIS_NETFEATURE_TWOMAPMODE	The toggle to use two-color mapping of the data when viewing network features, point, and regional polygon data. 1 – Use two-color mapping 0 – Do not use two-color mapping (default)
VIS_NETWORK_ACTIVITY_LOCATION_POINTSIZE	The size of an activity location point, 0.0 to 10.0.
VIS_NETWORK_BARRIER_POINTSIZE	The size of a barrier point, 0.0 to 10.0.
VIS_NETWORK_DETECTOR_POINTSIZE	The size of a detector point, 0.0 to 10.0.
VIS_NETWORK_NODE_POINTSIZE	The size of a node point, 0.0 to 10.0.
VIS_NETWORK_PARKING_POINTSIZE	The size of a parking point, 0.0 to 10.0.
VIS_NETWORK_TRANSIT_POINTSIZE	The size of a transit stop point, 0.0 to 10.0.
VIS_NETWORK_VIEW_ACTIVITY_LOCATIONS	The toggle to view activity locations. 0 – Do not view activity locations 1 – View activity locations

Configuration File Key	Description
VIS_NETWORK_VIEW_BARRIERS	The toggle to view barriers. 0 – Do not view barriers 1 – View barriers
VIS_NETWORK_VIEW_BOXES	The toggle to view boxes. 0 – Do not view boxes 1 – View boxes
VIS_NETWORK_VIEW_DETECTORS	The toggle to view detectors. 0 – Do not view detectors 1 – View detectors
VIS_NETWORK_VIEW_LINKS	The toggle to view links. 0 – Do not view links 1 – View links
VIS_NETWORK_VIEW_NODES	The toggle to view nodes. 0 – Do not view nodes 1 – View nodes
VIS_NETWORK_VIEW_PARKING	The toggle to view parking. 0 – Do not view parking 1 – View parking
VIS_NETWORK_VIEW_TRANSIT	The toggle to view transit stops. 0 – Do not view transit stops 1 – View transit stops
VIS_NODES_COLOR_BLUE	The blue color value for drawing nodes, 0.0 to 1.0.
VIS_NODES_COLOR_GREEN	The green color value for drawing nodes, 0.0 to 1.0.
VIS_NODES_COLOR_RED	The red color value for drawing nodes, 0.0 to 1.0.
VIS_OVERLAYMODE	The toggle to determine whether the Overlay mode is `on` or `off`. 0 – Overlay mode is `off` (default) 1 – Overlay mode is `on`
VIS_PARKINGS_COLOR_BLUE	The blue color value for drawing parking accessories, 0.0 to 1.0.
VIS_PARKINGS_COLOR_GREEN	The green color value for drawing parking accessories, 0.0 to 1.0.
VIS_PARKINGS_COLOR_RED	The red color value for drawing parking accessories, 0.0 to 1.0.
VIS_RIDEINVEHICLEMODE	The toggle to determine whether the Ride In Vehicle mode is `on` or `off`, 0 – Ride In Vehicle mode is `off` (default) 1 – Ride In Vehicle mode is `on`
VIS_SET_VEHICLE_ID	The ID of the vehicle to use for either the Follow Vehicle Mode or the Ride In Vehicle Mode. The value can be any vehicle ID.
VIS_SLIDER_SCALE	The scale, 1.0 and larger; Default = 1.0

Configuration File Key	Description
VIS_SLIDER_SPEED	The speed, 0.005 to 1.0; Default = 1.0
VIS_SLIDER_THRESHOLD	The threshold, 0.005 to 1.0; Default = 1.0
VIS_SLIDER_XROT	The X rotation, 0.0 to 360.0; Default = 0.0
VIS_SLIDER_YROT	The Y rotation, 0.0 to 360.0; Default = 0.0
VIS_SLIDER_ZROT	The Z rotation, 0.0 to 360.0; Default = 0.0
VIS_SUMMARY_BAR_COLUMN	Indicates which data column is used to calculate the height of the 3D Bars; it can be 0 to 9 and must be an integer (default 0). This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_BAR_THREEDSF	Indicates the amount to multiply the data value from the specified data column to determine the height of the 3D Bars to draw. It can be any number, but negative numbers should be avoided if the data column is non-negative (negative heights will be difficult to interpret).
VIS_SUMMARY_BARMMODE	The toggle to create 3D bar graphs from the data when viewing link space summary, variable size box, and link data. 1 – Use 3D bar graphs (default) 0 – Do not use 3D bar graphs
VIS_SUMMARY_COLORMAP_COLUMN	Indicates which data column is used for single color mapping; it can be 0 to 9 and must be an integer (default 1). This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_COLORMAP_MAX	The maximum value to use for the colormap when a single colormap is used. It can be any number. This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_COLORMAP_MIN	The minimum value to use for the colormap when a single colormap is used. It can be any number. This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_COLORMODE	The toggle to use single color mapping of the data when viewing link space summary, variable size box, and link data. 1 – Use single color mapping (default) 0 – Do not use single color mapping
VIS_SUMMARY_TRANSMODE	The toggle to use transparency filtering of the data when viewing link space summary, variable size box, and link data. 1 – Use transparency 0 – Do not use transparency (default)

Configuration File Key	Description
VIS_SUMMARY_TWOMAP1_COLORMODE	The toggle to define which color scheme to use for the first colormap when two color mapping is used. 0 – Black to Red is used (default) 1 – Black to Green is used 2 – Black to Blue is used This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_TWOMAP1_COLUMN	Indicates which data column is used for two-color mapping for the first colormap; it can be 0 to 9 and must be an integer (default 1). This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_TWOMAP1MAP_MAX	The maximum value to use for the first colormap when two-color mapping is used. It can be any number. This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_TWOMAP1MAP_MIN	The minimum value to use for the first colormap when two-color mapping is used. It can be any number. This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_TWOMAP2_COLORMODE	The toggle to define which color scheme to use for the second colormap when two-color mapping is used. 0 – Left to Right is used (default) 1 – Right to Left to Green is used This means that if the VIS_SUMMARY_TWOMAP1_COLORMODE is 0, a value of 0 would produce a Green to Blue colormap, whereas a value of 1 would produce a Blue to Green colormap. This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_TWOMAP2_COLUMN	Indicates which data column is used for two-color mapping for the second colormap, can be 0 to 9 and must be an integer (default 1). This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_TWOMAP2MAP_MAX	The maximum value to use for the second colormap when two-color mapping is used. It can be any number. This setting applies to viewing link space summary, variable size box, and link data.

Configuration File Key	Description
VIS_SUMMARY_TWOMAP2MAP_MIN	The minimum value to use for the second colormap when two-color mapping is used. It can be any number. This setting applies to viewing link space summary, variable size box, and link data.
VIS_SUMMARY_TWOMAPMODE	The toggle to use two-color mapping of the data when viewing link space summary, variable size box, and link data. 1 – Use two color mapping 0 – Do not use two color mapping (default)
VIS_THREEDBARMODE	The toggle to determine whether the 3D Bars are displayed or just 2D color-filled rectangles will be displayed. 0 2D – Color-filled rectangles will be displayed 1 3D – Bars will be displayed (default) Note: This switch only applies to Variable Size Box Data, and it overrides the VIS_SUMMARY_BARMODE configuration file key.
VIS_THREEDNETMODE	The toggle to determine whether the 3D Network mode is on or off. 0 – 3D Network mode is off (default) 1 – 3D Network mode is on
VIS_TRANSITS_COLOR_BLUE	The blue color value for drawing transit stops, 0.0 to 1.0.
VIS_TRANSITS_COLOR_GREEN	The green color value for drawing transit stops, 0.0 to 1.0.
VIS_TRANSITS_COLOR_RED	The red color value for drawing transit stops, 0.0 to 1.0.
VIS_VEHICLE_DRAW3D	The toggle for 2D or 3D vehicles. 0 – 2D vehicles 1 – 3D vehicles
VIS_VEHICLE_DRAWMODE	The coloring method for vehicles, 0 to 0 – Same color mode 1 – Color by Type mode 2 – Color by Passengers mode 3 – Color by Velocity mode 4 – Random coloring by vehicle ID 5 – Color by User field mode
VIS_VEHICLE_POINTSIZE	The size of a vehicle when it is a point, 0.0 to 10.0

Appendix E: Default Colormap Input File Format

```
15 92
5 0.0 37.5 Summary Velocity Map 0
1.0 4
3.0 3
15.0 11
30.0 1
35.0 0
5 0.0 1.0 Summary Density 1
0.1 11
0.2 1
0.3 5
0.5 3
1.0 4
5 0.0 49.0 Emissions Velocity Map 2
1.5 4
4.5 3
22.5 11
45.0 1
50.0 0
5 0.0 25.0 Emissions Nitrogen Oxide Map 3
5.0 0
10.0 1
15.0 2
20.0 3
25.0 4
5 0.0 620.0 Emissions Carbon Monixide Map 4
120.0 0
240.0 1
360.0 2
480.0 3
615.0 4
5 0.0 13.2 Emissions Hydrocarbons Map 5
2.6 0
5.2 1
7.8 2
10.4 3
13.0 4
5 0.0 18.0 Emissions Fuel Economy Map 6
3.6 0
7.2 1
10.8 2
14.4 3
18.0 4
5 0.0 26000.0 Emissions Flux Map 7
5000.0 4
10000.0 3
15000.0 2
20000.0 1
```

```
25000.0 0
5 0.0 26000.0 Unused Map 8
5000.0 4
10000.0 3
15000.0 2
20000.0 1
25000.0 0
5 0.0 18.0 Unused Map 9
3.6 0
7.2 1
10.8 2
14.4 3
18.0 4
5 0.0 18.0 Unused Map 10
3.6 0
7.2 1
10.8 2
14.4 3
18.0 4
5 0.0 18.0 Unused Map 11
3.6 0
7.2 1
10.8 2
14.4 3
18.0 4
12 0.0 255.0 Vehicles by Type Map 12
1.0 0  Walk
2.0 1  Auto
3.0 2  Truck
4.0 3  Bicycle
5.0 4  Taxi
6.0 5  Bus
7.0 6  Trolley
8.0 7  Streetcar
9.0 8  Light Rail
10.0 9 Rapid Rail
11.0 10 Regional Rail
255.0 11 Unknown type
15 0.0 255.0 Vehicles by Passengers Map 13
1.0 0  0 passengers
2.0 1  1
3.0 2  2
4.0 3  3
5.0 4  4
6.0 5  5
7.0 6  6
8.0 7  7
9.0 8  8
11.0 9 10
26.0 10 25
51.0 11 50
101.0 12 100
```

```
201.0 13 200
255.0 14 255
5 0.0 37.5 Vehicles by Velocity Map 14
1.0 4
3.0 3
15.0 11
30.0 1
35.0 0
15 0.0 255.0 Vehicles by User Field Map 15
1.0 0  0
2.0 1  1
3.0 2  2
4.0 3  3
5.0 4  4
6.0 5  5
7.0 6  6
8.0 7  7
9.0 8  8
11.0 9 10
26.0 10 25
51.0 11 50
101.0 12 100
201.0 13 200
255.0 14 255
```

Appendix F: Single Colormap Text Input File

```
5 0.0 18.0   // number of colors, minimum value and maximum value
3.6 0    // 0.0 to 3.6 is in color 0
7.2 1    // > 3.6 to 7.2 is in color 1
10.8 2   // > 7.2 to 10.8 is in color 2
14.4 3   // > 10.8 to 14.4 is in color 3
18.0 4   // > 14.4 is in color 4
```

Single colormap text files are used to produce binary single colormap files for use in the Output Visualizer. They are converted with the *mk1binmap* utility.

Appendix G: Error Codes

Error codes for the Output Visualizer are in the range 34000 – 34999.

Code	Description
34000	Not used.
34001	Not used.
34002	Not used.
34003	Mandatory configuration file key(s) not specified. Edit the configuration file keys in your configuration file to make sure all of the mandatory file keys are specified. A list of the unspecified keys is listed along with the output.
34004	Incorrect number of arguments were supplied. The proper usage is `Vis <config file>.`
34005	Network exception caught. The Network subsystem has caught an exception. This is most likely to be a missing table.
34006	An exception is caught by the VIS subsystem. Most likely, the problem is inconsistent data.
34007	Can't open input file. The input file does not exist.
34008	Can't create file for output. A file cannot be created in the directory specified. Check the permissions in the specified directory. If the permissions are ok, check for disk space limitations.
34009	Not enough random access memory (RAM) when trying to allocate memory. Add more memory to the machine, reduce the size of the file to be loaded, or quit other memory using programs and retry.
34010	Can't read input file header. The header is missing in the file entirely or is missing a mandatory field. If a specified field is missing, it will also be printed.
34011	Node is missing. A node that is not present in the currently loaded data was referenced but not found. Check for consistency in the Link and Node tables.
34012	Link is missing. A link that is not present in the currently loaded data was referenced but not found. Check for consistency in the Link and Node tables.
34013	Number of NET and VIS nodes disagree. A problem in internal data consistency has occurred. Check the node and link tables for consistency.
34014	Number of NET and VIS links disagree. A problem in internal data consistency has occurred. Check the node and link tables for consistency.
34015	A node that is referenced by a link is not on the given link. Both the link and the node are printed. Check the node and link tables for consistency.

Chapter Eight: Index